Pro-poor Intervention Strategies in Irrigated Agriculture in Asia

Poverty in Irrigated Agriculture: Issues and Options

INDONESIA

Intizar Hussain, editor

Study Team:
Sigit S. Arif,
Mochammad Maksum,
Murtiningrum,
Suparmi,
Slamet Hartono,
Agnes Mawarni,
Rahardjo,
Saiful Rochdiyanto,
Intizar Hussain and
Deeptha Wijerathna

International Water Management Institute

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Country Report

Poverty in Irrigated Agriculture in Developing Asia: Issues, Linkages, Options and Pro-Poor Interventions

Indonesia

Intizar Hussain, editor

Study Team/Contributors
Sigit S. Arif
Mochammad Maksum
Murtiningrum Suparmi
Slamet Hartono
Agnes Mawarni
Rahardjo
Intizar Hussain

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Contents

Tables and Figures

Figures:

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Considering that the Indonesian irrigation management policy has just been shifting towards the human-centered development by promoting new values, concepts, strategies and implementation frameworks, the Center does believe that the study is very timely. It is expected that findings and recommendations of the study would be meaningful lessons that could be learned as part of experiences in the early years of that new policy implementation.

Several research approaches were adopted in completing this study covering, among others, the Focus Group Discussions (FGDs) and public consultation in the form of National Workshops. In validating the findings, several irrigation resource persons comprising knowledgeable bureaucrats, NGOs and academia were invited to join a peer group formed by the Center to review the final report of this study. It is fair to conclude that through such approaches, the findings would be better publicly legitimated. Based on this, the Center optimistically believes that the findings of this study would inspire any institutions concerned in irrigation development towards achieving a more effective move.

On behalf of the Center, I would like to take this opportunity to express the greatest gratitude and deepest appreciation in acknowledging with thanks the trust and financial support of IWMI that have made this study possible. In addition to that, I would like to convey the highest appreciation of the Center to Dr. Intizar Hussain, IWMI Project Manager, for his patience, his smile and intensive project reviews that must be done to bring any activity connected with this study in compliance with the right path as has been well documented in the Work Plan of this study.

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Finally, I would also like to take this opportunity to confirm the team availability to accommodate any response and criticism of the readers to this report. Constructive criticisms are always welcome. We do believe that significant enrichment of this report in favor of our people at the grass-roots level and the citizen majority could always be done by the team, based on such a constructive criticism.

Mochammad Maksum
CRRDS Director
Yogyakarta, March 25, 2003

Glossary and Abbreviations

Glossary

AD/ART:	Rule of organization
APBN:	National revenue and expenditure government budget
APBD:	Regional revenue and expenditure government budget
Aquifer:	Permeable water-bearing formation capable of yielding exploitable quantities of water
BPD:	Board of Village Representative
Canal:	Man-made open channel, usually of regular cross sectional shape
Discharge:	Volume of water flowing through the river (or channel) cross-section in a unit of time
DPIK:	Regency irrigation management fund
Drainage:	Removal of surface water or groundwater from a given area by gravity or by pumping
Development Fee:	Farmers' contribution beside ISF
Ecosystem:	System in which, by the interaction between the different organisms present and their environment, there is a cyclic interchange of material and energy
Government Regulation:	Regulation drawn up by the President
IMT	An approach to empower people by transferring the management of irrigation system at all levels
Inpres:	Instruction of the President
Irrigation:	Artificial application of water to lands for agricultural purposes
ISF:	Aims to provide funding of O&M of irrigation system
Kepmendagri:	Decision of Minister of Home Affairs
Kepmenkimpraswil:	Decision of Minister of Settlement and Infrastructure of Territory
KPL:	Official who is doing guidance and counseling in irrigation matters
Tabukan:	Surjan system, where a part of the land is higher
Ledokan:	Surjan system, where a part of the land is lower
Musyawarah:	Focusing group discussion includes product of agreement in the meeting
Orba:	New regime
PP:	Rule of government
PIK:	Program on small-scale irrigation system
PRA:	Method of research and real condition of rural participation
Recharge:	Process by which water is added to an aquifer, either directly into a formation, or indirectly by way of another formation
Regional Regulation:	Regulation drawn up by Head of Regency or Governor
Runoff:	The part of precipitation that appears as streamflow
SK:	Letter of Decision
UUPA:	Agrarian regulation
Bawang daun:	Includes vegetable crops (*Allium fistulosum*)

Abbreviations

CI:	Cropping intensity
DS I:	First dry season
DS II:	Second dry season
GDP:	Gross Domestic Product

GNP:	Gross National Product
GR:	Government regulation
HH:	Questioner household
HTERW:	Head-tail equity ratio
II:	Irrigation intensity
IMT:	Irrigation management transfer
IWRM:	Integrated water resources management
NW:	Northwest
ISF:	Irrigation service fee
OCW:	Output per unit of consumed water
ODW:	Output per unit of diverted irrigation water
O&M:	Operation and maintenance
OPE:	Overall system efficiency
RRA:	Rapid rural appraisal
RR:	Regional regulation
RIS:	Relative irrigation water
RS:	Rainy season
RWS:	Relative water supply
PRA:	Participatory rural appraisal
WDC:	Water delivery capacity
WDP:	Water delivery performance
WUA:	Water user association
WUAF:	Water user association federation
SE:	Southeast

Study Background

Past agricultural development efforts in Indonesia have primarily focused on achieving self-sufficiency in rice. National irrigation systems were developed as rice-based systems to support macro-level objective of rice self-sufficiency. Poverty alleviation, agricultural commercialization of agricultural sectors, crop diversification, farmers' participation, as well as indigenous capacity, to mention a few, had never been taken into serious consideration in any irrigation development planning, design and implementation programs. Achievement of self-sufficiency in 1984 was the only success indicator of irrigation development, leaving the majority of the farmers staying around the poverty line.

In the aftermath of the Indonesian financial crisis, it is now nationally accepted that the rice-biased agricultural development of Indonesia has been blamed as one among the factors stimulating the nation's crisis that was considered as an event waiting to happen.

Development progress of Indonesia at that time presented a typical case of the *successful* economic development model of a country with a very authoritarian and interventionist state. Within the last two decades, the country's economic development has been very successful in improving the people's standard of living. Annual growth rate of the GDP improved remarkably to around 7 percent in the 1990s with an annual population growth rate of only 1.69 percent. Through both the trickle-down effects and direct policy measures for poverty alleviation, the percentage of poor population was drastically decreased from above 60 percent in the 1960s to 40 percent in 1976, and further reduced to around 11 percent in 1996, a year before the crisis.[1]

However, this economic success that was mainly concentrated on the growth accumulation process with unlimited support of the state building efforts[2] was often not properly accompanied by strong attention to agricultural development needs. Among many others, income security and poverty alleviation, farmers' choice on crop selection, people participation in development, indigenous capacities in rural and agricultural areas were reported as poorly improved as compared to industrial and urban sectors.

Unlike the economic shock experienced by several neighboring countries, without nullifying the contribution of their noneconomic variables, the Indonesian economic shock is multidimensional in nature. Intensive domination of the noneconomic variables has made the country's economic shock a *total crisis*[3] with even more escalating human-security problems.

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[1] Maksum, Mochammad. 1998. Alternative Economy-Road to Food Security. Paper presented at the International Conference on Food Security. Conducted by HEKS (Swiss Interchurch Aid) in Bacolod City. Philippines, 19-24 June 1998. Read also: Kuswanto, Kapti Rahayu and Mochammad Maksum. The Implication of the Asian Financial Crisis on Southeast Asia: The Case of the Food and Agricultural Sector of Indonesia. Presented at the Second Regional Experts Workshop on Food and Agricultural Policy. Bangkok, 17-19 August 1999.

[2] Mas'oed, Mohtar; M. Maksum and Moh Syuhada, eds. 2000. Kekerasan Kolektif: Kondisi dan Pemicu (Collective Violence: Condition and Precipitation). P3PK-UGM. ISBN-979-95263-9-6.

[3] Maksum, Mochammad. 2000. CSOs' Role in Enhancing Human Security in Asia: The Case for Indonesia. Paper presented at the Third Intellectual Dialogue on Building Asia's Tomorrow: "Cross Sectoral Partnership in Enhancing Human Security." Organized by the Japan Center for International Exchange (JCIE) and the Institute of Southeast Asian Studies (ISEAS), in Bangkok, June 18-19, 2000.

Poor attention to various dimensions of agricultural development, combined with decreasing purchasing power of the nation due to the crisis, has drastically downgraded Indonesia into a country group classified as the Low Income Food Deficit Countries (LIFDCs).[4]

A total crisis had invited a nationwide political movement. At the culmination of a nationwide public movement, Soeharto who had been the ruler for more than three decades, responded by stepping down as President of the country, and allowed his Vice President, Habibie to replace him on May 21,1998. The period of Habibie Presidency was considered by many as a transitional government until the election of Abdurrahman Wahid as being the fourth President, based on a legitimate electoral process, a year later.

One political problem has been solved. The fourth President is considered as the product of a very legitimate democratization. However, many development problems are still persisting. The nation is still adjusting from being a very authoritarian government for many decades towards another political equilibrium developed under more democratic measures and towards the supremacy of civilians. The agriculture sector is also adjusting as well as irrigation development policies towards the supremacy of farmers, through a more comprehensive development paradigm.

As a consequence of the industry-biased authoritarian orientation, the former irrigation policies, programs and implementations have been extremely dominated by the government to attain the country's self-sufficiency in rice. In turn, irrigation system design and development, which have been significantly concentrated on rice volumetric-production, have never been very sensitive to poverty alleviation, income generation, commercial agricultural development and welfare attainment programs. The growth-equity-sustainability objectives of agricultural development were very poorly attained.

Irrigation reform policy has been formulated to accommodate more comprehensive agricultural development objectives summarized as the *critical triangle* of agricultural development,[5] covering *growth, equity and sustainability* objectives. However, moving from being centralized and rice-based irrigation development that had left the farmers at or below the poverty line, towards the supremacy of the farmers to be above the poverty line in the near future, is not an easy task to attain during this transitional era.

Aside from physical constraints in shifting from being rice-based towards multi-commodity based agriculture the implementation of irrigation reform policy is facing serious economic as well as sociocultural constraints. Comprehensive reorientation, which is nonnegotiable needs to be assessed, formulated and implemented to come up with sound pro-poor irrigation system interventions.

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[4] Read MISSION REPORT on Indonesia of the FAO Special Program for Food Security (1998).

[5] Maksum, Mochammad. 1997. On the Critical Triangle of Agricultural Development in Developing Countries. In People Based Sustainable Agricultural Development for a Global World, ed. Maksum, Mochammad: Agus Setyarso and Dyah Ismoyowati. Center for Rural and Regional Development Studies, Gadjah Mada University. ISBN-979-95263-1-0.

Irrigation Development Issues

General Issues

National Irrigation Policy has been newly reformed from being rice-based irrigation towards welfare-based irrigation development. As the most important stakeholders, farmers have to be considered as the central orientation of irrigation development. Persisting characteristics of the irrigation strategic environments have been functioning as potential problems constraining system improvement in attaining policy's full impact on overall irrigation stakeholders during earlier years of implementation.

Existing bureaucratic capacity has not been very appropriate and positively responding to the newly reformed irrigation policy. Very poor accommodation to farmers' participation, among many other examples, could be taken as a strong indication of very poor bureaucratic response. At the farmer's level, limited land size and ownership status and institutional structure are not appropriate enough to the newly developed irrigation paradigm. Agricultural supporting systems, such as market environment, condition of irrigation infrastructure, rural finance and extension services, could also be mentioned as some of the many problems faced during this reformation period. Due to these constraints, we have to admit that the capacity of irrigation development and management in contributing to the nation's poverty alleviation efforts could be significantly improved through necessary improvements.

Specific Issues

In addition to the general problems constraining irrigation contribution to poverty alleviation as mentioned earlier, at the scheme level, the existence of the inter-scheme characteristic variability could be easily observed. They include, among others, landownership status, land size, unclear water rights, available farming technology, limited efficiency awareness, participatory variability, institutional capacity, market accessibility, policy bias, system governance and bureaucratic capacity. Poor irrigation management leads to inequitable distribution of benefits from irrigation. Consequently, the nationwide effectiveness and efficiency performance of the irrigation system could be reported very poor, as far as distributive, welfare and commercial issues are concerned.

The national irrigation policy has recently been reformed. Welfare-based irrigation is being chosen as primary orientation of irrigation system development and management. Since the abovementioned development and management constraints are multidimensional in characters, early implementation period of such reform policy has not demonstrated a remarkable progress. At the bottom level, any adjustments (technical, economic and the sociocultural) or interventions must be perceived as locale-specific and must be in line with regional development interests and capacity within the context of regional autonomy which is being implemented by the Government of Indonesia.

Based on the statement of the problems, therefore, the study attempted to answer a set of question as follows:

1. What are the implications of new agricultural and irrigation policy reforms related to the poor?

2. What is the capacity of the irrigation bureaucracy to support the implementation of the newly developed irrigation policies? To what extent are farmers and other stakeholder programs derived from the new irrigation policies?
3. What are the opportunities and constraints in shifting the irrigation systems from rice-based to a more welfare-based one? What are necessary pro-poor measurements to facilitate such a shift?
4. What is the distributive performance of the irrigation system in terms of equitable distribution of benefits of irrigation at system level?
5. What interventions might be required to develop a pro-poor irrigation policy?

Goal and Objectives

The general objective of the study is to analyze and promote policies as well as strategies at all levels for alleviating poverty through pro-poor interventions in rural areas of Indonesia. It is also to analyze, prioritize, and recommend necessary technical and non-technical pro-poor interventions for improving performance of an established irrigation system.

The study is focused on some various characteristics of irrigated areas and their peripheries with a large number of people under persistent poverty in Indonesia. The emphasis is on identifying and assessing a set of appropriate economic, financial, institutional, governance and technical intervention at field as well as system levels and change in overall policy and institution framework to facilitate better access of the poor to irrigation water resources. The study covered:

1. A thorough assessment of the poverty situations in selected irrigation systems.
2. Analysis and field research on the impact of underlying physical, economic and sociocultural conditions of selected study areas in particular and on the overall irrigation system at large, including the assessment of opportunities and constraints on improving productivity in less-productive areas through improved access to irrigation water.
3. Identification and in-depth evaluation of a range of potential pro-poor economic, financial, institutional, governance, and technical intervention at field and system levels against set criteria.
4. Formulation of a set of an appropriate intervention and policy as well as an institutional framework, including an adequate support system required ensuring large-scale uptake, replicability and higher impacts in Indonesia. Furthermore, this culminated in the formulation of the Indonesian version of action agendas for the pro-poor irrigation intervention in the selected areas.

Organization of the Report

This report consists of eight chapters. Chapter 2 deals with a description of the study area. All aspects of irrigation management including the legal aspect and existing institutions at all levels started from the highest level, i.e., national level down to irrigated sample area, are discussed. Chapter 3 deals with methodology of the study, starting from the premise to the method of data collection and analysis. Chapter 4 discusses the assessment of poverty in irrigated areas and analysis of linkages between poverty and irrigation. Chapter 5 discusses the performance of irrigation system and its associated impact on poverty. Chapter 6 deals with the assessment of institutional intervention and innovation. The report is summarized in chapter 7. Finally, in chapter 8 this report is closed by an action agenda to develop pro-poor national interventions.

Part — 1

Poverty and Irrigation in Indonesia: An Overview

PART 1

Poverty and Irrigation in Indonesia: An Overview

1.1. POVERTY IN INDONESIA: AN OVERVIEW

Before the financial crisis in 1997, Indonesian economy performed well, and the country had been able to improve the economic conditions of the people. Macro economic indicators such as economic growth, inflation rate, income per capita and Gross National Product (GNP) as well as Gross Domestic Product (GDP) indicate that the Indonesian economy was stable and the overall macroeconomic performance was reasonable. From 1987 to 1996, the Indonesian economy grew at an average annual rate of over 6 percent, the inflation rate was below 10 percent, and balance of payment deficit was about 2–2.3 percent of the GDP. Per capita income in early 1997 was US$1,200.

During the pre-crisis period, agricultural development of the country had been promising. The agriculture sector played an important role in providing employment opportunities to over 50 percent of the population, which depended directly or indirectly on this sector. While the contribution of agriculture to GDP has been declining (from 60% in the mid-1960s to 16% in the mid-1990s), the sector still makes a significant contribution in absolute terms. Its relative growth has also been reported decreasing as a consequence of the country's industrialization, but its role in assuring the national food security and in providing raw material to the secondary sector has been important.

The most powerful indicator of the success of the Indonesian development strategy is the degree of absolute and relative poverty reduction. During 1976-1996, the numbers of poor people had drastically decreased, from 54.2 million (40.1%) and 40.6 million (26.9%) in 1981 and 1984, to 27.2 million in 1990 and 22.5 (11.3%) in 1996. In 1997, during the economic crisis era, the number of poor people increased to 47.97 million (15.64 million in urban areas and 32.33 million in rural areas). The proportion of poor people in 1999 was similar to that in 1981 and 1984. According to the Central Bureau of Statistics (CBS), 2002, the poor people numbered 37.3 million (9.1 million in urban areas and 28.2 million in rural areas). CBS data show that poverty incidence had decreased from 24 percent in February 1999 to 17 percent in February 2002. Regional distribution of the poor shows that more than 59 percent are located in Java-Bali, 16 percent in Sumatera and 25 percent in Kalimantan, Nusa Tenggara, Maluku and Papua.

In Indonesia, the family size makes a lot of difference. Large-size families tend to be poorer. In rural areas, the average family size of the poor households is 4.7 persons compared to 3.8 persons for the nonpoor households. However, in urban areas, family size of the poor is 4.9 compared to 4.0 persons for the nonpoor family. Generally, poor people are characterized by a low level of education and are highly dependent on agricultural income (table 1.1.1).

Table 1.1.1. Characteristics of the poor and non-poor in Indonesia.

Characteristics	Non-poor households		Poor households	
	Urban	Rural	Urban	Rural
1. No. of persons in the family	4.0	3.8	4.9	4.7
2. Woman family leader (%)	13.93	13.39	11.84	12.41
3. Length of education of household leader (years)	8.0	5.1	4.7	3.6
4. Agriculture as main income (%)	6.29	58.66	21.14	75.97
5. Owner of main income source (%)	57.36	76.93	63.34	80.82
6. Area of house < 45 m^2 (%)	34.88	34.47	51.02	47.15
7. Accessibility to safe water (%)	91.39	57.45	82.11	38.56
8. Electricity (%)	94.48	78.44	94.45	59.50
9. Hours of man-days / week	45.30	37.30	41.40	35.70

Source: Authors' compilation (1996-1999).

The initiative for the development and prosperity of families began with the launching of the first long-term Development Plan. The program development culminated with the establishment of the Act No. 10/1992 on Population Development and the Development of Prosperous Family followed by the enforcement of Government Regulation No. 21/1994 on Population Development. This showed recognition and commitment of the Government of Indonesia for the important role of population in national development.

Since 1994, the Government of Indonesia has been registering the families on regular a basis. The purpose of this registration is to monitor the progress on the family's prosperity and development and to evaluate the programs. Indicators of prosperity also include those related to religious, social and cultural aspects. In order to monitor the progress of a prosperous family, indicators are translated into the various stages of welfare of Indonesian families, namely Pre-Prosperous level, Prosperous Stage-I, Stage-II, Stage-III, and Stages-III plus.[6] Data on family welfare stages are then transferred to a 'working chart' developed to assist families to become self-reliant. In order to accelerate transition of prosperity stages, development support or interventions, deriving from government and private sectors, are needed. For example, to accelerate the number of families from Pre-Prosperous to Prosperous Stage-I, it is necessary to assist the families to improve their living standards on a wider spectrum. The assistance could be

[6] Pre-Stage prosperous families are those unable to fulfill the minimum basic needs, such as spiritual needs (cannot perform the religious prayers according to their own respective religion), food (minimum two meals per day), clothing (more than one pair of clothes) and housing (the greater portion of the floor is not earthen), health and family planning (brought to the health center in case of illness). Meanwhile the Prosperous Stage-I family is a family that has met its minimum physical needs but has not fulfilled the social and psychological needs, such as family interactions, neighborhood interactions and jobs, which determine a good living standard.

in the form of encouraging families in practicing the religious aspects, encouraging a person to make use of health facilities, or convincing them to join family planning programs and other reproductive health care programs.

Besides the family development program, the government has implemented other poverty alleviation programs before and with the above program, such as IDT program or the presidential decree program on poverty alleviation for rural areas, implemented at the village level.

In addition, to accelerate the transition of prosperity stages, the government decided to link the development of prosperous family to poverty alleviation schemes not only in the IDT program but also in less-remote places. Although the proportion of poor people in less-remote areas is smaller than that of the IDT villages, in absolute terms, the number of poor people in less-remote areas is significant.

The "Prosperous Family Savings" or Takesra was created as one of the ways to create awareness and educate Indonesian families on savings and on being development agents in their villages. Besides encouraging people to save, Takesra also functions as the collateral of Kukesra (Prosperous Family loans). The Takesra and Kukesra are carried out through group schemes.

Poverty in Indonesia

Literature on poverty in Indonesia mostly focuses on rural poverty especially in Java. Clifford Geertz stated that involution farming caused poverty in rural Java. An unbalanced landownership structure means an inequality in incomes of the rural society. Geertz also investigated the history of colonial domination by describing that the colonizer power through new technology and capital had caused poverty among rural people in Java. In that process, Java farming society became static. While their land became smaller, the population rose and they had no other occupation but farming.

Data from the agricultural census of 1993 indicate that the number of small farmers (with less than 0.5 ha) has been increasing over time. This phenomenon is more pronounced in outer Java than in Java (tables 1.1.2 and 1.1.3). The number of small farmers in the outer Java Island increased from 2.2 million in 1983 to 2.8 million in 1993 (27.3%). Also, rapid industrialization in urban and peri-urban areas has resulted in a significant amount of agricultural land converted to industrial uses. Overall, while marginal small farmers and small farmers (holding less than 0.5 ha) constituted 57 percent, they occupy only 26.8 percent of the total agricultural lands.

Table 1.1.2. Marginal/small farmers ('000).

Location	Urban		Rural		Total	
	1983	1993	1983	1993	1983	1993
Java Island						
- DKI Jakarta	20	8	0	0	20	8
- West Java	159	255	2,178	2,236	2,337	2,491
- Central Java	173	213	2,2041	2,236	2,214	2,449
- D.I Yogyakarta	20	93	248	211	267	304
- East Java	153	182	2,312	2,633	2,466	2,815
Outer Java Island	192	198	2,039	2,641	2,230	2,839
Indonesia	717	949	8,817	9,957	9,534	10,906

Source: Agricultural Census 1993 (BPS 1994).

Table 1.1.3. Structure of agricultural landownership in Indonesia.

Wide land grouping	Agricultural households		Landownership
	Total	%	%
No. of farmer who have no area and farmers with < 0.10 ha	5,989,534	28	10.1
0.10 – 0.49 ha	6,315,091	29	15.7
0.50 – 0.99 ha	3,986,876	18	53.8
1.00 – 5.00 ha	5,062,371	23	20.4
> 5.00 ha	383,128	2	-
Total	21,737,128	100	

Source: Based on data from Agricultural Census 1993.

Agricultural laborers are important in agriculture. An agricultural laborer is a laborer who works for farmers or in agricultural business.

From 1983 to 1993, the population of agricultural laborers in Indonesia increased from 5.03 million to 9.05 million (or 79.9% over the period or around 8% per year). In Java, the population of agricultural laborers increased from 4.24 million in 1983 to 6.73 million in 1993 (or 58.6% over the period or 5.9% per year) (table 1.1. 4).

Table 1.1.4. The Number of agricultural laborers' households ('000).

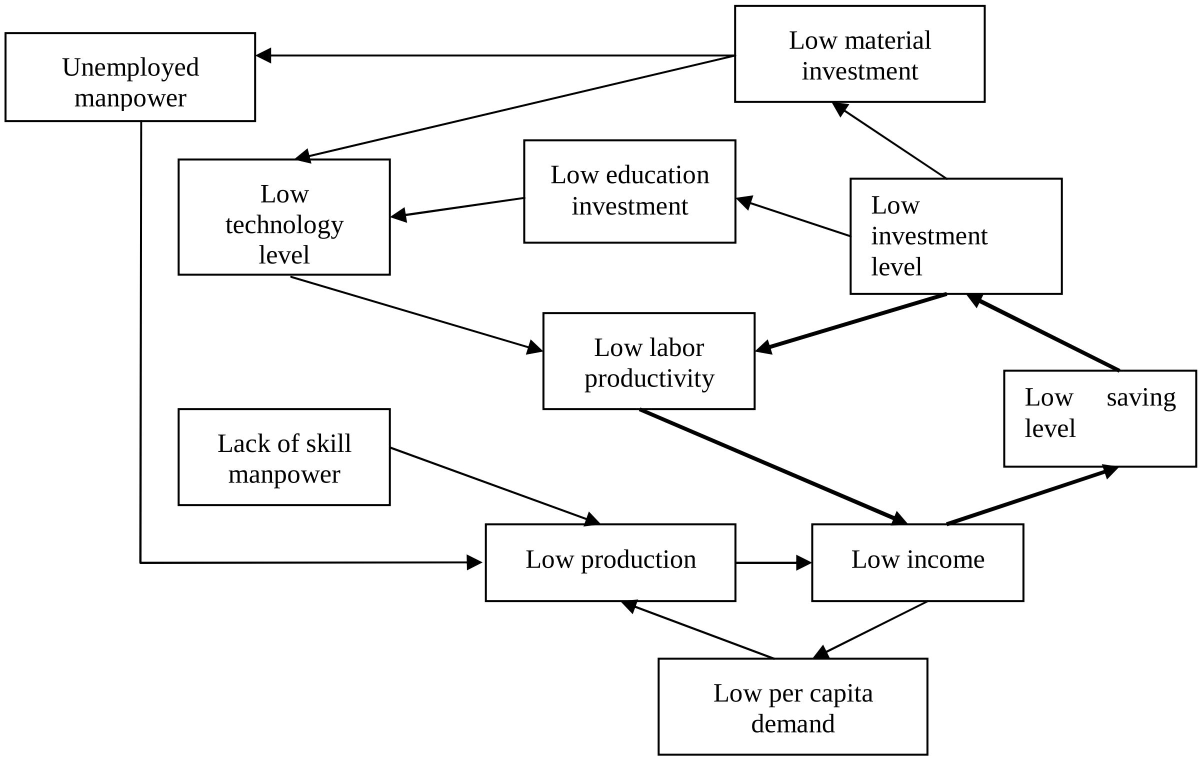
Location	Urban		Rural		Total	
	1983	1993	1983	1993	1983	1993
Java Island						
- DKI Jakarta	3	3	0	0	3	3
- West Java	52	143	1,365	1,952	1,417	2,095
- Central Java	48	143	1,115	1,848	1,163	1,996
- D.I Yogyakarta	5	36	97	102	102	138
- East Java	82	162	1,477	2,338	1,559	2,500
Outer Java Island	29	94	759	2,228	788	2,322
Indonesia	219	586	4,813	8,468	5,032	9,054

Source: Agricultural Census 1993 (BPS.1994).

Perceptions of Poverty

Different people perceive poverty in different ways. According to Levitan (1980), poverty is a lack of needed things and services to gain a reasonably comfortable standard of life. Howard and Adler (1978), and Prayitno and Arsyad (1987) perceive poverty as a multidimensional phenomenon, meaning that since human needs are many, poverty also has many aspects. Primary aspects of poverty include poverty of assets, knowledge and skills. Secondary aspects include poverty of social network, funds and source of information. These poverty dimensions are manifested as lack of food consumption (that bring about malnutrition), unhealthy housing, bad health care, low educational standard, and many others (*Prayitno and Arsyad, 1987)*. Thus poverty has both economic and noneconomic dimensions. Economic or material dimension is reflected in basic human needs, such as the need for food, clothing, housing and health care. These needs can be measured in money terms (rupiah). Unlike the monetary dimension, measurement of social and cultural dimensions is more qualitative. Nonmonetary aspects of poverty (related to society, politics, power) are related with the economic dimension. If the "poor culture" values cannot be eliminated, the economic poverty will be hard to overcome. In structural or political contexts, a person who experiences economic poverty is the one who experiences structural or political poverty, too. Poor people have no access to get involved in the political process; they do not have any political power. Therefore, they are placed in the lowest social structure (Heru Nugroho 1995).

Figure 1. Vicious circle of poverty.



Malassis developed a vicious circle of poverty, which describes the factors that cause poverty. In the diagram, items linked by bold lines show the core of the poverty circle, which is low productivity that caused low income, low saving and low investment. The circle will go on unless an action cuts the link. Another factor that determines the poverty in a region is an unfortunate natural condition, even with the existence of technology and capital that is provided (Hadi Prayitno and Lincoln Arsyad 1987).

There are many ways to measure poverty with a variety of standards. Thus, the illustration of poverty also varies. There are two types of poverty: absolute poverty and relative poverty. First, absolute poverty is a condition where one's absolute income cannot fulfill his basic needs like food, clothing, housing, health care and education. The real consumption is shown quantitatively and/or in monetary terms according to prices in a certain base year. Second, relative poverty is quantified based on income distribution proportion in a certain region. This type of poverty is said to be relative since it is more related with an income distribution among the social classes. For instance, it compares national income proportion that is enjoyed by a certain social class with other social classes. However, the main poverty-measuring tool nowadays is the first type. Some poverty line measurements that have been conducted in Indonesia will be explained in the next section.

Sajogyo's Criterion

In Indonesia, Sajogyo is the founder of an idea about poverty line that was developed through a Study on Efforts of Family Nutrition Improvement (*Studi Usaha Peningkatan Gizi Keluarga* - UPGK) in 1973. He used a kilogram unit of rice equivalent to determine the poverty limit criterion. The method multiplies consumption quantity in kilograms of rice per capita at current rice prices and average number of family members (assumed to be five persons). Based on this criterion, Sajogyo classified the community into four groups as shown in table 1.1.5.

Table 1.1.5. Sajogyo's criterion of poverty lines.

No.	Criterion	Measurement (Income in kg rice equivalent/person/year)	
		Rural	Urban
1.	Very poor	< 240	< 360
2.	Poor	240 – 320	360 – 480
3.	Almost poor	320 – 480	480 – 720
4.	Not poor	> 480	> 720

Source: Gunawan Sumodiningrat 1999.

By using the criterion, Sajogyo predicted that about 46 percent of the Indonesian population lived below the poverty line in 1969, with 40 percent poor in urban areas and 46 percent in rural areas. After some adjustments, Sajogyo suggested that the Indonesian poor population was 42.54 million in 1970, which decreased to 46.60 million in 1976 (Sajogyo 1994). Changes in poverty in Java and other regions over time are shown in table 1.1.6 below.

Table 1.1.6. The percentages of poor population based on Sajogyo's Three Poverty Lines in 1976, 1981 and 1984.

No.	Location /Criterion	Year					
		1976		1981		1984	
		Rural	Urban	Rural	Urban	Rural	Urban
1.	Indonesia						
	a. Very poor	29.4	25.2	9.1	12.0	12.4	11.9
	b. Poor	18.2	24.5	14.5	14.9	16.4	12.2
	c. Almost poor	26.8	24.8	26.4	29.9	30.2	26.0
	d. Not poor	25.6	25.5	50.0	43.2	41.0	53.5
2.	Java						
	a. Very poor	35.9	27.7	11.2	14.8	13.2	13.0
	b. Poor	21.2	18.3	17.7	15.4	19.4	14.6
	c. Almost poor	22.3	21.7	32.2	26.7	31.0	26.0
	d. Not poor	20.5	32.3	38.9	43.0	36.4	46.4
3.	Other regions						
	a. Very poor	19.5	22.8	4.1	8.4	10.3	9.2
	b. Poor	16.4	19.6	8.9	13.6	12.7	12.1
	c. Almost poor	-	-	28.4	31.9	29.1	29.1
	d. Not poor	-	-	58.6	46.1	47.9	49.6

Note: Rice prices: In 1976, Rp 121.70/kg (implicit price). In 1981, in rural area, Rp 211/kg. and in urban area, Rp 244/kg. In 1984, rural area, Rp 211/kg and in the city, Rp 360/kg (estimation).

Criterion of the Central Bureau of Statistics

The Central Bureau of Statistics (BPS) defines an alternative measure of poverty line in terms of minimum calorie requirement per day. The Bureau calculates population below the poverty line based on the Susenas data that are updated every 3 years to capture the changes in society's consumption patterns. The poverty line is calculated for rural and urban areas separately. The poverty line used by BPS has been changing periodically. The habit of consuming rice as one's main food influences the minimum expenditure to fulfill a certain amount of calorie requirement (Darmin Nasution 1995). The limit of expenditure value is based on the food requirement of 2,100 calories per capita per day as determined by Widya Karya Nasional Pangan dan Gizi 1978 (BPS 1999). The expenditure required to meet this calorie requirement is added with expenditure on nonfood needs, such as housing, clothing and other things and services. Besides using the above criterion, BPS also uses the composite index, based on other characteristics of the poor, such as living places, land owned and occupied, education level and household head's working hours. Table 1.1.7 shows the population below the poverty line (as per BPS criterion) from 1976 to 1999.

Table 1.1.7. Poverty line and number of population below the poverty line.

Year	Poverty line (Rupiah)		Population below the poverty line (million)		
	Urban	Rural	Urban	Rural	Urban + Rural
1976	4,522	2,849	10.0	44.2	54.2
1978	4,969	2,981	8.3	38.9	47.2
1980	6,831	4,449	9.5	32.8	42.3
1981	9,777	5,877	9.3	31.3	40.6
1984	13,731	7,746	9.3	25.7	35.0
1987	17,381	10,294	9.7	20.3	30.0
1990	20,614	13,295	9.4	17.8	27.2
1993	27,905	18,244	8.7	17.2	25.9
1996	38,246	27,413	7.2	15.2	22.4
1998	52,470	41,588	17.6	31.9	49.5
1999	92,409	74,272	15.6	32.3	47.9

Source: Statistical Year Book of Indonesia 1999.

As per BPS poverty line, population below poverty line has decreased drastically from 54.2 million or around 40.1 percent of the total population in 1976 to only 27.2 million or 15.1 percent in 1990. Out of the number in 1990, 17.8 million of the poor lived in rural areas. The number of poor people further reduced to 22.4 million in 1996. However, because of the economics crisis that overwhelmed Indonesia at the end of 1997, poverty figures increased sharply, and millions of people became poor again. In 1998, the number of poor people increased to 49.50 million. In 1999, the economic and political situation improved, resulting in some reduction in poverty again. Based on the 1998 figure, the number of poor people decreased by about 1.6 million. Depth of poverty, as measured by the poverty gap index, is given table 1.1.8 during pre- and post-crisis periods. As can be seen, depth of poverty increased significantly in 1998, and decreased during the post-crises period.

Table 1.1.8. Poverty gap index by grouping area 1996-1999.

		1996	1998	1999
Java – Bali	Urban	2.724	4.622	2.675
	Rural	3.297	4.366	3.776
Sumatra	Urban	1.688	2.533	2.409
	Rural	2.535	2.945	1.984
Others	Urban	2.794	5.291	3.127
	Rural	5.287	8.560	6.424
Indonesia	Urban	2.548	4.351	2.671
	Rural	3.529	5.005	3.876

Source: Perkembangan tingkat kemiskinan dan beberapa dimensi sosial 1996–1999.

Since the Indonesian population is mainly concentrated in Java, the majority of the poor people live in Java and Bali (estimated at 28.9 million). Sumatra being the second largest in population it is home to 8.6 million poor people (table 1.1.9). In all regions, poverty is more in rural areas than in urban areas. Almost 80 percent of the household heads of the rural poor families work mainly in the agriculture sector (table 1.1.10).

Table 1.1.9. Population below the poverty line in rural and urban areas by groups of islands, 1999.

No.	Groups of islands	Population below the poverty line (million)		
		Rural	Urban	Total
1.	Sumatra	6.0	2.6	8.6
2.	Java + Bali	17.5	11.3	28.9
3.	Kalimantan	1.9	0.3	2.2
4.	Sulawesi	2.3	0.7	3.1
5.	Other Islands	4.6	0.6	5.2
6.	Western part of Indonesia	23.5	13.9	37.5
7.	Eastern art of Indonesia	8.8	1.7	10.5

Source: Statistical Year Book of Indonesia 1999.

Table 1.1.10. The percentages of poor family and non-poor family, based on the main income of the household leader.

No.	The main income resources of the household leader	Urban	Rural	Urban + Rural
1.	Poor family			
	a. Agriculture	25.55	79.54	62.00
	b. Industry	12.06	5.19	7.42
	c. Trade	21.55	5.03	10.40
	d. Services	14.33	2.77	6.53
	e. Income transfer	4.66	2.36	3.10
	f. Others	21.85	5.11	10.55
	Total	100.00	100.00	100.00
2.	Nonpoor family			
	a. Agriculture	6.98	58.33	41.86
	b. Industry	12.26	6.65	8.45
	c. Trade	22.95	11.38	15.09
	d. Services	26.26	9.77	15.06
	e. Income transfer	10.57	4.48	6.43
	f. Others	21.38	9.37	13.11
	Total	100.00	100.00	100.00

Source: Central Bureau of Statistics. Jakarta 1994.

Criterion of the World Bank

The World Bank uses two types of poverty lines, that is, poverty line of US$75 and US$ 50 of income per capita per year. The poverty rate is determined by multiplying these income levels with Rp 420 (dollar rate in the free market in 1976) and the average number of family members (5 persons). Using these poverty lines, Sumitro reported that in Java and Madura, poverty decreased from 94 percent (or 63.9 million) in 1967 to 79 percent in 1970 (or 57.4 million), and to 32 percent (or 25.3 million) in the early 1990s.

Poverty decreased from 21.4 percent in 1984 to 17.2 percent in 1987, and further decreased to 15.3 percent in 1990. Table 1.1.11 shows the dynamics of poverty for these years.

Table 1.1.11. The Percentages of the poverty level based on regions, 1984–1990.

Area	Year	Java + Bali	Outside Java + Bali	Indonesia
Urban	1984	25.0	18.4	23.1
	1987	21.0	17.6	20.1
	1990	18.5	16.0	17.8
Rural	1984	23.6	16.0	20.9
	1987	17.8	14.0	16.2
	1990	12.5	16.5	14.2
Urban + Rural	1984	24.0	16.9	21.4
	1987	18.8	14.8	17.2
	1990	14.6	16.7	15.3

Source: Data for 1984–1987 from The World Bank 1990. Data for 1990 from Susenas 1990. Yossie, M. et al. LPEM-FEUI in Darmin Nasution.

Criterion of the National Family Planning Coordinator Institution (BKKBN)

BKKBN (1993) divides the family prosperity stages into five levels:

1. Pre-Prosperous Family: the families that have not yet fulfilled their minimum basic needs, such as food, clothing, housing and health care.
2. Prosperous I Family (first stage): the families that could fulfill their minimum basic needs but have not yet fulfilled all of their social and psychological needs, such as education, family planning, social interactions and transportation.

3. Prosperous II Family (second stage): the families that could fulfill their basic needs and their social and psychological needs, but have not been able to fulfill all of their developmental needs, such as those related to savings and information access.
4. Prosperous III Family (third stage): the families that could fulfill their basic needs, social and psychological needs, and developmental needs, but are unable to provide a maximum contribution to the community, such as regularly giving material and fund contributions for social interests, and actively participating in social institutions or social, religious, sports, educational organizations and other related matters.
5. Prosperous III Family (third stage) plus, the families that could fulfill their basic needs, social and psychological needs, and developmental needs and, furthermore, they could make contributions to the society on a regular basis.

Table 1.1.12 provides data on number of families, based on the above categories.

Table 1.1.12. Number of families by the prosperity stages in 2000.

No.	Province	Total of household leader	Pre-prosperous and prosperous I families			Prosperous II families	Prosperous III families	Prosperous III plus families
			Due to economic reason	Due to non-economic reason	Total			
1.	Jakarta	1,416,395	136,133	230,639	366,772	442,091	480,120	127,412
2.	West Java	10,234,030	28,058,831	2,073,740	4,879,579	2,894,900	2,015,915	443,678
3.	Central Java	7,753,687	2,774,885	1,957,963	47,828,848	1,605,761	1,148,236	266,840
4.	DIY	749,527	202,859	156,873	359,732	100,473	165,016	44,306
5.	East Java	9,061,591	2,764,513	1,942,774	4,707,287	1,977,142	1,885,485	491,679
6.	Outer Java	18,155,101	5,993,693	3,399,619	9,383,312	4,968,939	3,182,165	620,685
7.	Indonesia	47,370,331	14,667,914	9,761,616	24,429,530	12,069,314	8,876,937	1,994,550

Source: BKKBN, Jakarta 2000.

1.2. IRRIGATION IN INDONESIA: AN OVERVIEW

In Indonesia, irrigation was basically developed for increasing paddy production through expansion in irrigated areas, which constituted 69 percent of the total area in 1985. Between 1989 and 1993, average area harvested of paddy is estimated at 12.27 million hectares (table 1.2.1). Over 28 percent of the paddy area comes under technical irrigation systems, followed by around 22 percent under simple irrigation. Over one-fifth of the total paddy area is classified as rain-fed area. Technical irrigation grew rapidly during earlier decades. Semi-technical irrigation decreased during the 1970s, and remained more or less stable afterwards. Table 1.2.2. provides time series on irrigated area, planted area, yield of rice production in Indonesia, 1968-1988.

Table 1.2.1. Distribution of the harvested area of paddy according to water management ('000 hectares).

Year	Technical irrigation	Semi technical irrigation	Simple irrigation	Rain fed	Tidal swamp	Upland	Total
1989	3,278	1,744	2,651	2,586	503	1,238	12,000
1990	3,527	1,787	2,648	2,483	527	1,178	12,145
1991	3,330	1,844	2,834	2,456	575	1,412	12,457
1992	3,445	1,619	2,823	2,591	671	1,199	12,348
1993	3,699	1,581	2,719	2,480	602	1,326	12,407
Average	3,456	1,715	2,736	2,519	576	1,271	12,272
Percentage	28.16	13.97	22.29	20.53	4.69	10.36	100.00

Source: IPB and Bappenas 1997.

Table 1.2.2. The development of irrigated area, planted area, yield of rice, and rice production in Indonesia, 1968-1988.

Year	Irrigated area (million ha)	Planted area (million ha)	Yield of rice (tons/ha rice)	Rice production (million tons)
1968	3.35	8.05	1.29	11.67
1969	3.27	8.01	1.53	12.25
1970	3.32	8.14	1.61	13.14
1971	3.37	8.32	1.65	13.72
1972	3.40	7.90	1.67	13.18
1973	3.43	8.40	1.74	14.61
1974	3.53	8.52	1.79	15.28
1975	3.63	8.50	1.79	15.19
1976	3.71	8.37	1.89	15.85
1977	3.81	8.36	1.91	15.94
1978	3.88	8.93	1.96	17.53
1979	3.94	8.80	2.03	17.87
1980	4.02	9.01	2.24	20.16
1981	4.41	9.38	2.38	22.29
1982	4.23	9.02	2.57	23.19
1983	4.26	9.16	2.63	24.08
1984	4.29	9.64	2.66	25.93
1985	n.a.	9.90	2.70	26.54
1986	n.a.	9.99	2.71	27.01
1987	n.a.	9.91	2.77	27.45
1988	4.40	10.09	2.82	28.40
Growth rate	1.93	1.06	4.70	4.81

Source: Asnawai (1988).
Note: n.a.= Not available.

Technical irrigation grew at the rate of 1.5 percent per year between 1969 and 1987, with the growth rate of around 3.7 percent per year in areas outside Java and 0.5 percent per year in Java. Even though the growth of technical irrigation was faster in areas outside Java, the overall technical irrigation in Java was more than in other regions (75% of the total technical irrigation in 1987). Generally, the efficiency of irrigation in areas outside Java was still low because it required time to stabilize the paddy field layer and the improved management of water distribution. As a result, the outcome was far from satisfactory. In contrast, performance of irrigation systems in Java is relatively better. This condition enables to apply production technology with the better response. Table 1.2.3. provides data on the development of irrigated area in Java and outer Java.

Table 1.2.3. The development of irrigated area in Java and outer Java (ha).

	1981	1985	1990	1999
Java	2,516,210	2,482,376	2,535,665	2,604,782
Outer Java	1,621,215	1,671,236	1,911,983	2,427,689
Total	4,137,425	4,153,612	4,447,648	5,032,471

Source: Many sources from BPS (Statistic Indonesia).

Productivity varies across different types of areas and irrigation systems (table 1.2.4). Productivity differences are caused not only by per hectare yield differences but also by differences in cropping intensity. Generally, cropping intensity of paddy in irrigated areas is more than 150 percent, with the highest intensity in technical irrigation systems (of 181%). The average cropping intensity in other areas was 100 percent with the highest intensity in rain-fed area of 111 percent per year. Cropping intensity has, thus, a strong relationship with the availability of water and its improved control and management.

Table 1.2.4. Paddy productivity based on the type of irrigated area.

No.	Type of irrigated area	Productivity (tons/ha)
1.	Technical	5.15
2.	Semi technical	4.87
3.	Simple	4.50
4.	Village	4.37
5.	Tidal swamp	1.75
6.	Rain-fed	3.11
7.	Upland	1.00

Source: Asnawai 1988.

Productivity is lowest in the tidal swamp area, i.e., 1.75 tons of dry paddy per hectare, while productivity is highest in areas with technical irrigation systems estimated at 5.15 tons of dry paddy per hectare. The interesting phenomenon is that the productivity of rain-fed areas is relatively high at 3.11 tons per hectare. It was higher than the productivity of upland paddy, estimated at 1.8 tons per hectare. Overall, irrigation has made a significant contribution to total paddy production in the country.

History of Irrigation: Overview

Since 1945, just after the end of the Second World War, many Asian and African countries gained their independence. One common problem that these countries faced was shortage of food for the growing population. To overcome this problem, most of those countries focused their development policy on the agriculture sector with the main objective of increasing food production and farmers' income. In this policy setting, development of the irrigation sub-sector played an important role.

As in other countries, Indonesia also focused its development policy on the agriculture sector to attain self-sufficiency in rice. Under this policy, the role of development of irrigation infrastructure in the country seemed very significant. From the late 1960s to early 1990s, 5.5 million hectares of technical irrigated area were developed and rehabilitated in the country. In addition, another 1.5 million hectares were irrigated through village irrigation systems. Most of the area under technical irrigation systems is located in the island of Java.

Indonesia is located in the monsoonal climate region and is blessed with abundant rainfall. Approximately 21 percent of the Asia Pacific region's freshwater resources or 6 percent of the world's resources is available in the country throughout the year. Due to the nature of the climate, most Indonesian farmers grow paddy during the wet season. Paddy cultivation is in fact an ancient practice in Indonesia.[7] While the country has attained self-sufficiency in rice, it has been importing rice since the late 1980s.

Precolonial Period (Hindu-Buddhist and Islamic Kingdom)

Indonesia is an archipelago of more than 17,000 islands, covering a land area of 1.92 million km^2 with a coastline exceeding 84,000 kilometers. There are many different cultures in the country. The population (200 million at present) is unevenly distributed across different regions. Java, which is a relatively smaller island covering about one-sixth of the country's total area, is home of around 60 percent of the total population. Java has been the center for development in Indonesia. Several inscriptions indicate that developed agrarian villages had existed since the early part of the second millennia.[8] Lombard (2000) and Van Setten van der Meer (1979) have stated that some irrigation systems have existed in Central Java and East Java since eighth century and ninth century, respectively.

According to Adams in Van Setten van der Meer (1979) the growth of irrigation societies followed two stages. The first is the formation to the florescent, from the beginning of irrigation and sedentary farming to a rapid growth wherein the surplus is largely in the hands of the priestly hierarchy, with consequent building of monumental religious structures in urban centers and the beginning of warfare. The second is the dynasty, with a separation and institutionalization of secular-politics and religious-economics, which controlled the true urban centers.[9]

Collier divided the development of irrigation societies into four categories as: a) early formative, a period of expansion of existing irrigation; b) late formative, a period of expanding irrigation systems; c) regional florescence, full exploitation of the technology, which was developed during the formative period, with intensive agriculture based on elaborate irrigation systems and an increasing importance of the warrior class; and d) empire, with land controlled by the state, taxation in the form of labor on state agricultural lands and on public works, as well as service in the army, personal service to the ruler and the nobility.[10]

In the early stages of development, irrigation systems were developed on a smaller scale, consistent with theory of development of Adams and Collier. The nuclear village settlements, administered by a head and council of elders, would over a long period, have developed into irrigation centers administered by a central authority. This was mostly in Java and Bali.

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[7]See Lombard 1996, vol. 3. *Nusa Jawa: Silang budaya. Warisan kerajaan-kerajaan konsentris*. (The Island of Java: A cross of culture. The heritage of concentric kingdoms). Kartodirdjo and Suryo 1994, *Sejarah Perkebunan di Indonesia*. (The history of plantation estate in Indonesia) and Van Setten van der Meer 1979. Sawah cultivation in ancient Java. Aspects of development during the Indo-Javanese period, 5th to 15th century. According to them a. hydraulic society had already existed in Java since a couple centuries before Christ. The society had been capable of establishing and managing the irrigation system in the area appropriately since the early second millennium.

[8] See Lombard, D. 2000, vol.3; Van Setten van der Meer 1979.

[9] Adams. R. Developmental stages in ancient Mesopotamian. In Van setten van der Meer 1979, 6-7.

[10] Collier. D. Development of civilization on the coast of Peru. In Van setten van der Meer 1979, 6-7.

In Bali, a specific irrigated-agro-religion society called Subak has developed and managed its own irrigation system independently through government at the village or higher level. According to history, Subak has already existed since ninth century (Hutapea 1996; Windia 1993; Van Setten van der Meer 1979). Similar irrigation societies may have existed in Java during the Hindu and Islamic kingdom hundreds of years before the colonial period. One inscription tells us that a Great King Hayam Wuruk of Majapahit kingdom and his government employees had to pay all they spent for food during their visit in the autonomous village area near Mojokerto, East Java, which was headed by a Hindus priest[11] and the rulers assisted the development of the area including irrigation systems.

There was independency of a specific irrigation society from the government interventions. Farmers, in groups, managed irrigation democratically. Irrigation development used to be part of the village development. During the early stage in the eighth and ninth centuries, Javanese village development process followed a similar model. An individual family or some families headed by the eldest started to develop a community as a village nucleus in a specific location. The eldest was then regarded as head of village. In an old Javanese word, he is called as *rama* or *raka*, which means father.

As competition among *rama*s emerged in the nearby areas, the strongest became the leader in the larger area. It seems that most Javanese kingdoms were established through this process. This process of village development occurred in Central Java and East Java from the eighth to the thirteenth centuries. This was quite different from the development of a village in West Java during later periods, seventeenth to eighteenth centuries, under the Dutch colonialists.[12] In the later case, the colonial government strongly influenced the development of the villages, which led to the dependency on the government.

The village development was usually associated with the development of irrigated paddy fields surrounding the village in a very simple way. People built a headworks just after they found an appropriate location in the river course and constructed distribution channels to irrigate their own land evenly. Most of the systems used semipermanent structures. Headworks were made from local material such as bamboo, wood and stones, so farmers could maintain and repair the structures when floods or other natural calamities caused damage to the infrastructures. Arif (1999) in his study about Subak traditional irrigation society in Bali suggests that farmers adopted this method as one of the ways implementing the sustainable development concept. In this way they practiced the Hindu's harmony concept, called *Tri Hita Karana* or three components in harmony, i.e., harmony among God, nature and human beings.[13] Very old irrigation systems that used this concept still exist, with good performance. Besides Bali, this system is also found in West Java and other parts of Indonesia.[14]

In East Java, a unique inscription was found, which was written twice on the same stone. The first was in the tenth century by King Airlangga and tells us that a strong weir was built in the Konto river course. The second was rewritten by one of the Kings of Majapahit in the

[11] See Lombard 2000.
[12] Ibid.
[13] Arif 1999, Implementation of concept of Tri *Hita Karana* for sustainability of Subak irrigation system infrastructures.
[14] Kurnia, 1998.

fourteenth century. The last inscription tells us about the rehabilitation and reconstruction of a simple weir in the Konto river in a better and stronger way to secure the irrigated area from threats of routine floods, which may come frequently every year.[15] This inscription also tells us about the natural problems faced by East Javanese, including volcanic eruption, sedimentation due to volcanic material, floods, water shortages and drainage problems in the estuary of several main rivers. These same problems are also faced in modern times and they have adverse impacts on the lives of the people.

In the development of an irrigation system, the specific irrigation water rights were established. Most Indonesian farmers practiced the riparian water right and to some extent it is mixed with common property right or appropriation right. All people who participate in development of irrigation system's infrastructure get some more privileges in water allocation and management. The privilege varies from place to place.[16] In Subak, Bali, the pioneer had the right to get more irrigation water compared to the ordinary farmers who did not actively participate in the development of the systems. This right was transferable as a heritage to their children or other families who cultivate their lands or even to other people when the land is sold. In some cases, water rights were tradable.

Another variation of water rights is found in places such as Yogyakarta and Situbondo, East Java. Farmers who had land closer to water sources (usually those who initiated and participated in the early stages of irrigation development or construction works of the irrigation system) got the privilege to use irrigation water first. After the distribution of water in the upstream area is completed, then, if the water is still abundant, it would be shared downstream to the tail ends. In this system, people who came later usually developed the tail-end areas, after the originally designed irrigation system was completed and the irrigation water was considered enough for irrigated land enlargement. These types of water rights are also practiced in India and the Philippines.[17] [18]

In the early stages of development, irrigation systems were developed for subsistence production. Gradually the role of irrigation in agribusiness became important. During the period of the Majapahit kingdom, trading emerged as an important sector and Java was known as an important rice-producing region. The Government of the Majapahit kingdom that governed Nusantara (old name for Indonesia), placed Java Island as the center of its government and developed a complex and sophisticated bureaucracy of agricultural production system by establishing hierarchical jobs for agricultural development for more effective agribusiness. There were strong linkages between the villages and the central government. The bureaucrtic system of the Majapahit kingship is one of the models that was followed by other Javanese kingdoms that emerged later.

The emerging trading sector in the region was very attractive for people to come over, not only from other regions of Indonesia but from other parts of the world. In the middle of the

[15] Lombard 2000 and van Setten van der Merr 1979.

[16] Arif, S.S. et al. 1998. Keberlanjutan sistem irigasi pada masa jangka panjang II: Studi kasus di Jawa dan Bali. (Sustainability of irrigation system in the Second long-term development stage: Case study in Java and Bali.). Riset Unggulan terpadu VI. LIPI. (Unpublished report, in Indonesian).

[17] Wade. 1999. Village republic.

[18] Angeles, H. L. 1989. Irrigation water management. Lecture Note. CLSU. The Philippines (unpublished).

fifteenth century, Malaya was one of the important seaports in the region. It attracted the western people who were eager to establish their power in the region. The colonial rule started in the Asian region during this period. People from west came and established their power. The Portuguese, Dutch, British and Spanish competed not only in the trading sector but also in establishing political power in the region.

The Dutch Colonial Period

At the end of the seventeenth century, the Dutch came to the country and started their colonial rule for three and half centuries. At the beginning, the Dutch colonial government paid little attention to irrigated agriculture. They were more interested in spices, which had a high tradable value in the European market at that time.

However, due to increased demand for several plantation commodities, the Dutch colonial government launched a new policy called "forced plantation program," which forced Indonesian farmers to cultivate high-value tradable plantation commodities, such as sugarcane, tobacco, tea and coffee on their lands.

Under this policy, the colonial government adopted several strategies, including the development of modern irrigation systems in the country to support sugarcane and tobacco plantations. Most of the areas where irrigation was developed were located in the northern coastal plain area of Java and in the southern part of Java, i.e., Madiun area and Pekalen Sampean irrigation system in East Java, and in the kingdoms of Yogyakarta and Surakarta (both are located in Central Java). Even now these areas are famous for special varieties of cigarette tobacco.

According to the National Research Council (1994) the development of water resources management in the country, during the colonial period, has had specific characteristics as follows:

a) The status of water resources was changed from common pool resources to economic resources, based on the colonial government objectives – to raise land tax and increase colonial government revenues.
b) Technical irrigation systems were developed in relatively fertile land areas and were mainly designed and constructed to satisfy the agronomic criteria of sugarcane and tobacco cultivation. The development of technical systems was separated from village irrigation systems that had existed since long ago.
c) In technical irrigation systems, farmers were no longer owners of the system but worked as laborers for plantation estates companies. However, in village irrigation systems their status as owners remained unchanged;
d) Land tax, roddi (*kerja paksa*) and forced-payment fee (*pemungutan)* from farmers to the water master at the tertiary levels were disadvantageous to farmers.
e) As a basic rule in the water-resources development sector the colonial government issued the water law in 1936. Based on this law, all provinces in the country issued the provincial and local-level water rules.

In real terms, the development of a huge irrigated area in the country made no significant contribution to farmers' welfare. More ironically, the most sufferers were those who lived in rural areas of Java, which used to have excellent irrigation systems in the country since ancient times. Java started to import rice from Thailand, Burma (Myanmar) and Vietnam since the early twentieth century.[19]

These problems were the outcome of unfair agricultural policies and strategies adopted by the colonial government. The colonial government financially gained, and Indonesian farmers suffered. This issue triggered several waves of protests from the parliament of the Netherlands-kingdom to the colonial Netherlands-India at the end of nineteenth century.

During the early twentieth century, the colonial government issued a new policy called the ethic policy. Under this policy, the Government of the Netherlands implemented three strategies, namely a) irrigation, b) education, and (c) transmigration. Under this strategy, the colonial government built some irrigation systems. One of the famous projects was the development of an irrigation system in the Demak district. The Glapan irrigation system was one of them. The main objective of the irrigation development was to alleviate poverty in the region. However, after several years of implementation the policy failed to achieve the stated objective. As a result, Java was still deficient in rice to meet its food requirements.[20]

Japanese Colonial Period and the Old-Order Government Period

From the Japanese colonial government in the early 1940s to the old-order government under the former President Soekarno, irrigation did not contribute significantly to the development in the country. This was due to several reasons including: a) the Second World War, followed by several civilian wars in the country, and b) insufficient budgets from the government for development, in general, in the country. As a result, most of irrigated systems were not maintained properly. Shortage of an O&M budget and inappropriate institutional arrangements were the main reasons for this insignificant contribution. At the end of the old-order government period, Indonesia became one of the poorest countries in the world. The GNP was much less than US$400 per capita and most people suffered from food shortages.

The New Order Government Period

In 1965, after the fall of the Old Order Government under former President Soekarno, the New Order Government led by former President Suharto emerged with strong support from the military regime. However, seemingly, the new-order government got the unhealthy country and inherited several hard problems from the previous government. In 1967, Indonesia was desperately poor and the economy was teetering on the brink of collapse. The agriculture sector, the major source of employment and income for two-thirds of the labor force, grew by only 1.4 percent per annum during 1960 and 1967. With the rural population rising to almost double, the incomes per capita and the living standards of the poor were on a downward trajectory. By 1967, the average per capita calorie intake was only about 1,800 calories a day, which was below the level of physical nutritional needs. About two-thirds of the population lived in poverty, with

[19] See Eumura 2000; and Gelpke 1986.
[20] Eumura 2000.

incomes too low to meet basic needs.[21] Problems of food shortage, monetary and economic crises, unemployment, poor conditions of the limited infrastructure and limited resources created insecurity and vulnerability to the sociopolitical life in the country.

In the mid-1960s, production and yield of rice were very low in Indonesia compared to those in other Asian countries. Since rice is the staple food of the vast majority of Indonesians (rice contributes about 70% of total calorie intake, while in Pakistan and India, rice contributes only about 30% [IRRI 1985]), the deficit in rice production emerged as one of the major problems for the Government of Indonesia (GOI). Initially, GOI had to import rice up to about 2 million tons a year. To increase availability of food and to enhance food security Indonesia became one of the biggest rice importers in the world.

Therefore, breaking the vicious circle of food insecurity and agricultural stagnation was one of the first priorities of the new-order government. In large part, this was accomplished through an emphasis on agriculture and rural development to increase rural output and farm income and improved nutritional standards.

To achieve this objective, the GOI launched a new policy on rice self-sufficiency. The policy was implemented through a three-pronged strategy: infrastructural construction, provision of production incentives and institutional development. Incentives were provided in part by supporting the price of rice and by subsidizing fertilizer and pesticides. Institutions were established, in particular, the agricultural extension services for many million of farmers.[22]

These three strategies were implemented consistently until rice self-sufficiency was achieved in 1984. However, the GOI spent a lot of money to implement this policy. From 1969 to 1984, more or less US$ 2.5 million had already been spent by the GOI in water the sector development (see annex 2). A large part of this amount was a loan from both multilateral and bilateral donors. In the mid-1960s, high-yielding varieties of the green revolution contributed substantially to increasing rice production in the country The HYRV was grown in Indonesia for the first time in 1969 with a total area of 482,000 hectares.[23] This was started little bit late compared to other Asian countries, India initiated to plant the HYRV in 1966, Bangladesh in 1967, Pakistan in 1968, Malaysia in 1966 and Philippines in 1966, respectively.[24] The planted area then increased fast in line with the increasing rate of irrigated land area until rice self-sufficiency was attained in 1984. Following the achievement of self-sufficiency in rice, this policy was not consistently followed any more. Provision of the subsidy policy was withdrawn gradually in the mid- 1980s. Now, this policy is no longer implemented.

In implementing agricultural policy, they followed a top-down approach. By this approach the central government played a dominant role as the development agency. Almost all policies were developed and planned, funded and implemented by the central government in Jakarta. All ministries had their own representative offices in each province. In addition, the development programs were implemented on a project basis. These representative offices would act as project coordinators in the provinces. After the project had been completed, the central

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[21] Afiff, S. 1992. Keynote address of international seminar on "Integrated development and management of water resources for sustainable use in Indonesia," Cisarua, October 29-November 1, 1992.
[22] Afiff. 1992. Ibid.
[23] IRRI. 1985. World rice statistics, 1985. IRRI, Manila, Philippines.
[24] See IRRI. 1985. ibid.

government would transfer the management processes to either provincial or regency governments. The organizational structures were established based on Law no 5/1974 about basic principles for administration in the region.[25]

Irrigation management in the area became the responsibility of Provincial and District governments. To fulfill the responsibilities, irrigation committees were established at both provincial and district levels. The committees were responsible for developing irrigation plans in their respective responsibility area including determination of cropping plans and irrigation schedules.

In general, the development program launched by the new-order government is planned and implemented periodically every 5 years, which is called the "Five Years Development Plan" (*Perencanaan Pembangunan Lima Tahun*, *PELITA*). Moreover, every 25 years, the global developments are evaluated, with longer-term perspectives. The first stage of development was initiated in 1973. The GOI needed about 5 years to consolidate all security, political and economic systems in the country prior to the implementation of the first stage of development. In the early part of the first development stage, irrigation the subsector was selected as the first priority to be developed in water-sector development. Implementation of the development policy program on the water-resources sector during the rule of the new-order government from Pelita I to Pelita V is given in table 1.2.5.

Table 1.2.5. Implementation of the development policy program on water sector during the rule of new-order government.[26]

1. PELITA	Priority program
First PELITA 1968 – 1973	▪ Rehabilitation of irrigation system. ▪ Continuation of development of multipurpose water projects in limited number. ▪ Continuation of development of flood control in urban area in limited number. ▪ Commencing limited swamp development for agriculture. ▪ Introduction of river-basin planning in several basins.
1. PELITA	**Priority program**
Second PELITA 1973-1978	▪ Continuation of rehabilitation of irrigation systems. ▪ Planning for extension of irrigation systems. ▪ Starting of provision of raw water for urban water supply. ▪ Preparation for intensive extension in green revolution movement (BIMAS and INMAS). ▪ Continuation on development of flood control in urban area in limited number. ▪ Continuation of development of multipurpose water projects in limited number. ▪ Swamp development extension. ▪ Enacting of water resources development law.

[25] Sardjono, D. 1992. Water resources development policy and strategies. In Proceeding of Workshop on the Integrated Development and Management of Water Resources for Sustainable Use in Indonesia. Bogor, Cisarua.
[26] Sardjono. 1992. Ibid.

Third PELITA 1978-1983	▪ Continuation of rehabilitation of irrigation system. ▪ Implementation of extension of irrigation systems. ▪ Intensification of BIMAS and INMAS. ▪ Completion of first stage multipurpose water-sector development and planning for the new project. ▪ Procurement of heavy equipment for construction and dredging. ▪ Reorganization of Directorate General of Water Resources Development, DGWRD. ▪ Continuation of providing raw water for urban water supply.
Fourth PELITA 1983-1988	▪ Starting of extension and rehabilitation of irrigation system in outer land of Java. ▪ Issued on policy statement of O&M for irrigation systems. ▪ Continuation on swamp development. ▪ Rice self-sufficiency achievement. ▪ Introduction of investment in water-sector development program to the private sector ▪ Capacity building of human resources through higher education in overseas mastered program. ▪ Issued on several government rules on water-resources- development sector following the water-resources law.
Fifth PELITA 1988-1993	▪ Continuation of the rehabilitation irrigation system. ▪ Continuation of extension program. ▪ Some multipurpose water-sector projects completed. ▪ Extended private participation on the swamp-development project. ▪ Introduction of new water-sector development policy (build, operate, transfer or BOT) by involvement of the private sector in water supply. ▪ Introduction of a land-development program to private investment. ▪ Reorganization of DGWRD to anticipate implementation of Law on Spatial Planning. ▪ Solution of conflict in some inundated dam areas in the process of dam construction. ▪ Development of a river estuary. ▪ Introduction of the construction of a rubber dam in estuary and estuary-dam technique.

Even though these programs had been prepared and planned properly, some constraints and new problems have emerged. In the second and third PELITA, it was noticed that some programs were implemented inappropriately. For example, rice area development done by the Department of Agriculture did not match with the extension of irrigation system done by DGWRD. This was corrected and synchronized in the third and fourth PELITA. In this period, it was also recognized that demand for water for domestic and industrial uses had increased. Therefore, the new approach of integrated water-resources management was introduced in the following PELITA.

In the fourth PELITA, the need for participation of all stakeholders in water-resources development was emphasized; so the GOI issued a new government policy on O&M for irrigation management in 1987. Several programs to attract private-sector investment in water resources development are also recognized.

Irrigation and Poverty

The relationship between production inputs, particularly, capital and labor, and productivity is well known. The role of irrigation in increasing productivity is well recognized. World Bank (1982) and Asnawi (1995) argued that the contribution of irrigation to rice production in fully irrigated areas in Java was only 5 percent of increased paddy production, while the contribution of High Yielding Varieties (HYVs) and chemical fertilizers was 9 percent and 24 percent, respectively. The situation is, however, different outside Java. With low to middle levels of irrigation, the contribution of irrigation to productivity was 27 percent, while HYVS and chemical and fertilizer had almost no influence on productivity. In the country as a whole, contribution of irrigation to productivity is estimated at 16 percent, while that of HYVs and chemical fertilizer are estimated at 5 percent and 4 percent, respectively. Regional distribution of irrigated area, productivity, landownership and incidence of poverty are presented in table 1.2.6.

Table 1.2.6. Area irrigated, area of province, proportion of poor people and productivity per hectare.

No.	Province	Area irrigated (hectares)	Area of province (hectares)	% Irrigated area of province area (x)	% Poor people (y)	Productivity (qu/ha)	Owned area (ha)
1	Aceh	202314	5539000	0.036525366	14.75	41.57	0.42
2	North Sumatera	316778	7168000	0.044193359	16.74	42.68	0.32
3	West Sumatera	174410	4289800	0.040656907	13.24	44.55	0.35
4	Riau	42435	9456100	0.004487579	14.00	32.61	0.38
5	Jambi	40124	5343600	0.007508796	26.64	34.01	0.39
6	South Sumatera	84864	10295400	0.008242905	23.53	36.42	0.52
7	Bengkulu	48601	1978900	0.024559604	19.79	37.96	0.35
8	Lampung	167918	3538500	0.047454571	29.11	41.53	0.24
9	Bali	85310	563300	0.151446831	8.53	54.37	0.25
10	West Nusa Tenggara	339195	2015300	0.168309929	32.95	45.37	0.43
11	East Nusa Tenggara	78393	4734900	0.016556421	46.73	32.02	0.13
12	West Kalimantan	85845	14680700	0.005847473	26.18	27.25	0.44
13	Central Kalimantan	69098	15356400	0.004499622	15.05	25.11	0.53
14	South Kalimantan	53881	3653500	0.014747776	14.37	31.66	0.51
15	East Kalimantan	31074	21098500	0.001472806	20.16	32.78	0.34
16	North Sulawesi	64095	2748800	0.023317448	18.19	44.29	0.15
17	Central Sulawesi	109651	6368900	0.017216631	28.68	34.99	0.46
18	South Sulawesi	375536	6248300	0.060102108	18.32	43.59	0.47
19	Southeast Sulawesi	58167	3814000	0.015250918	29.51	36.73	0.33
20	Jakarta	2406	66400	0.036234940	3.99	48.64	0.46
21	West Java	906735	4317700	0.210004169	19.78	47.65	0.27
22	Central Java	722187	3254900	0.221876863	28.46	50.14	0.24
23	Yogyakarta	51381	318600	0.161271186	26.11	51.75	0.10
24	East Java	922073	4792300	0.192407195	29.48	51.99	0.25
25	Maluku	0	7787100	0	46.14	30.11	0.03
26	Papua	0	42198100	0	54.75	29.16	0.06

Source: Some publications from BPS1999.

In 1999, the highest area irrigated was in East Java (922,000 ha) followed by West Java (906,700 ha) and Central Java (722,200 ha). Productivity of paddy was highest in Bali (5.437 tons/ha), followed by East Java (5.199 tons/ha), Yogyakarta (5.175 tons/ha), Central Java (5.014 tons/ha), Jakarta (4.864 tons/ha) and West Java (4.864 tons/ha). Poverty was the highest in Papua (54.74% of the provincial population), followed by East Nusa Tenggara (46.73%), Maluku (46.14%). These data suggest that, in general, provinces with a higher proportion of area irrigated have a lower incidence of poverty. In the estimated equation below, while the relationship is not statistically significant, the sign of the estimated coefficient indicates an inverse relationship between irrigation and poverty.

Regression statistics	
Multiple R	0.057106655
R Square	0.00326117
Adjusted R square	-0.038269614
Standard error	11.98741782
Observations	26

ANOVA

	df	SS	MS	F	Significance F
Regression	1	11.28377977	11.28377977	0.078524163	0.781708691
Residual	24	3448.756466	143.6981861		
Total	25	3460.040246			

	Coefficients	Standard error	t. stat	P - Value	Lower 95%	Upper 95%
Intercept	24.57995364	3.027546772	8.118769254	2.42897E-08	18.3314055	30.82850178
X	-9.178968907	32.75610399	-0.280221632	0.781708691	-76.7842309	58.42629308

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Part — 2

Institutional Arrangements for Irrigation Management in India

2.1 Introduction

2.2 Institutional Development during the New Order Government

2.3 Irrigation Management Policy Reforms

PART 2

Institutional Arrangements for Irrigation Management in Indonesia: An Overview

2.1 INTRODUCTION

Irrigation in Indonesia has been known or hundreds of years. The *Subak*[27] irrigation, for example, has been in existence since 1071 (Pitana 1992). *Subak* is a system that integrates the sociocultural, farming and religious aspects of life. The unification of the agricultural and sociocultural background, which is supported by deep-rooted religious beliefs among the Balinese has made *subak* a sustainable irrigation system than the one which has been established and organized by the government. Other well-organized and well-managed traditional irrigation institutions are *panriahan pamokkahan* and *bendang* in the North Sumatera, and *panitia siring* in the South Sumatera (Ambler 1991). Ambler (1991) points out that the organization of traditional irrigation systems is more popularly known by using terms related to the (local) leader, such as *ulu-ulu* or *jogotirto* in Central Java, *ili-ili* in East Java, *keurjruen blang* in Aceh, *raja bondar* in North Sumatera, *tuo banda* or *siak banda* in West Sumatera, *raksa bumi* in West Java, *malar* or *punggawa* in Sumbawa, and *tudung sipulung* in South Sulawesi.

2.2 INSTITUTIONAL DEVELOPMENT DURING THE NEW ORDER GOVERNMENT, 1967-1998

The new-order government in Indonesia (1967-1998) established new laws and regulations for managing various sectors in the country. For the water sector, water resources development law was launched in 1974 (known as law no 11/1974), which was used as a basic legal instrument for development and management of water resources in the country until recently.[28] This law is based on article 33 of the national constitution of 1945 which considers water as a gift of the Almighty God that must be used for the welfare of the people. Also, water should be controlled and administered by the state since it is the only body that has the power.[29]

Based on this law, the government is empowered to administer all water resources. The government may authorize its agencies, in the central, regional (provincial and district level), and corporate agencies to implement the government's power in the administration of all water resources. The authority has been given to several agencies, i.e., the Ministry of Mining and Energy for groundwater administration and development of hydropower; the Ministry of Public

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[27] *Subak* is a traditional form of irrigation institution in Bali.

[28] According to Secretary for Water Sector Adjustment Program (in personal communication) this law is one of the legal aspect in water resources sector that is being tried to be reformed. The draft of the new law has already been endorsed to Parliament. But it has not been discussed until July 2002.

[29] See Soenarno. 1992. Institutional aspects of sustainable water resources development. In Proceeding of Workshop on the Integrated Development and Management of Water Resources for Sustainable Use in Indonesia. Bogor, Cisarua.

Works for the administration of surface water resources; the Ministry for Population and Environment for quality of all natural resources as well as the Ministry of Forestry for watershed protection. In order to implement Law no 11/1974, the government issued several regulations (*Peraturan Pemerintah*, *PP*), Presidential and Ministerial decrees and Ministerial regulations. Table 2.2.1. lists various government regulations related to water-resources management.

Table 2.2.1. Various government regulations for water-resources management.

Legal basis	Title
GR no. 22/1982	Administration of surface water
GR no. 23/1982	Irrigation management
GR no. 14/1987	Transfer of a part of public works affairs to provincial and district governments
GR no .27/1991	Swamps management
GR no. 35/1991	Rivers management
Ministry of Public Works Regulation (MPWR) no. 38/89	River basin division
MPWR no. 48/89	Water resources management within a river basin unit

Government Regulation No. 22/1982

Through GR no 22/1982, the administration of surface water resources has been divided into the following functions:
- Concept of water-resources administration
- Coordination of water-resources administration
- Priority of water-resources utilization
- Licensing of water-resources utilization
- O&M of water-resources structures
- Water-resources financing system
- Supervision for water-resources management

By Presidential Decree no. 84, the government has given the Ministry of Public Works (DPW) the duty to implement the government administration related to public utilities and their development including water resources. By Ministerial Decree no 211/ 1984, the DPW delegates the water-resources administration and development to Directorate General of Water Resource Development (DGWRD). Initially, involvement of the community in water-resources development and management was principally regulated through Law No. 11/1974 and GR No. 22/1982. The philosophy of community involvement was to generate a sense of belonging and responsibility of the community, especially beneficiaries of water resources. The participation was mostly directed at O&M in order to sustain the function of the infrastructure.

Government Regulation No. 23/1983

GR No. 23/1982 deals with the irrigation sector as it is the largest user of water. Specifically, GR No. 23/1983 focuses on a) irrigation use, b) drainage, c) construction of irrigation system, d) exploitation and maintenance of the irrigation system, and e) irrigation management. As per this GR, the regional government is responsible for the management of technical irrigation systems at primary and secondary levels. This GR also contains provisions for the participation of WUA in management and financing of their tertiaries for technical irrigation systems. For small-scale irrigation systems, the management is the responsibility of WUA or village under the supervision of the regional government.

Government Regulation No. 14/1987

With GR No. 14/1987, some of the duties and responsibilities have been given to the regional government, i.e., provincial agencies, for example, Provincial Irrigation Services. These include planning for irrigation water distribution, irrigation water distribution, irrigation water licensing, irrigation period, determination of irrigation priorities, construction and maintenance of the main system and its appurtenant work, O&M for the irrigation and drainage system, guarding and guaranteeing the function of the irrigation system and its appurtenant work, issuing permits for demolition and adjustment of the irrigation canals and their appurtenant works, and issuing of permits for construction, adjustment or demolition of other structures located in the area of irrigation system. The structure of the organization within the regional government is determined by the Ministry of Home Affairs through consultation with the Ministry of Public Works.

Ministry of Public Works Regulation no 48/1989

With MPWR No. 48/1989, the management of water resources is given to the regional government as 73 River Basin Unit for co-management. This means that the Lower Regional Government executes services as planned by the Central Government or the Upper Regional Government with the responsibility to advising the government. Two River Basin Units, namely Brantas and Citarum, are managed by corporation and fifteen River Basin Units are still managed by the Central Government because they cover more than one province or they play a strategic role in the national economy.

Formal Institutional Setup

The Directorate General of Water Resources Development is the central-level agency responsible for water resources. Other central-level agencies related to water resources are the Ministry of Agriculture, Ministry of Forestry and Ministry of Mining and Energy. In each province, a kanwil office has been set up as the representative of MPW for regulatory duties and guidance. Other bodies that deal with water resource are the corporate bodies owned by the Department of Finance under the guidance of MPW. In West Java, Perum Otorita Jatiluhur manages the Citarum river basin and Perum Jasa Tirta in East Java manages the Brantas river basin.

At the regional level, the Ministry of Home Affairs through several Dinas or provincial agencies has set up the structure of regional organization, which consists of provinces and districts. One of these is the provincial agency for public works as Sub-Dinas Pengairan for 20 provinces and Dinas Pengairan for 7 provinces. Water projects are implemented through project implementation units. These are directed by the Central Government, and usually only O&M projects are directed by Dinas.

Irrigation Water Management

There are several uses of freshwater. In Indonesia, the priority for freshwater use is regulated in Law No. 11/1974 based on engineering planning to fulfill people's need. The priorities are: a) drinking water, domestic water, and municipal water; b) agriculture, livestock, plantation and fisheries, and c) energy, industry, mining, transportation and recreation. Water use for agriculture or irrigation is given second priority. However, agricultural water being the major water-using sector, management of irrigation water is considered an important part of water-resources management.

Prior to the launching of irrigation management policy reform in the country, irrigation management procedure applied in Indonesia is an O&M-form system, which consists of 16 O-form for operation procedure and 18 P-form for maintenance procedures. The O&M procedures are given in figures 2.1.1 and 2.1.2.

Operational Procedure

The O-form procedure, as shown in figure 2.1.1. consists of three stages i.e. determination of crop planting area, determination of irrigation service discharge, and monitoring and data gathering. O-form procedure starts with determination of cropping pattern by WUA (O-01 form). The input from WUA is then given to the water master (O-02 form) and then to the higher-level officer (O-03 form and O-04 form) to determine an overall or global planting pattern. The global planting pattern becomes a basic tool to determine cropping pattern in the area. In the implementation procedure, the actual planting area of each crop (O-04 and O-05 forms) is used to calculate the irrigation water requirement. The K-factor or ratio between actual river discharge and irrigation water requirement shows whether river discharge (O-06 form) is adequate to fulfill irrigation requirement. In case K equals unity or more, water is allocated to tertiary blocks according to irrigation requirements. If the K factor is less then 1, water is allocated in proportion of irrigation requirement. Additionally, monitoring activities such as collection of rainfall data and discharge data are also included in the procedure.

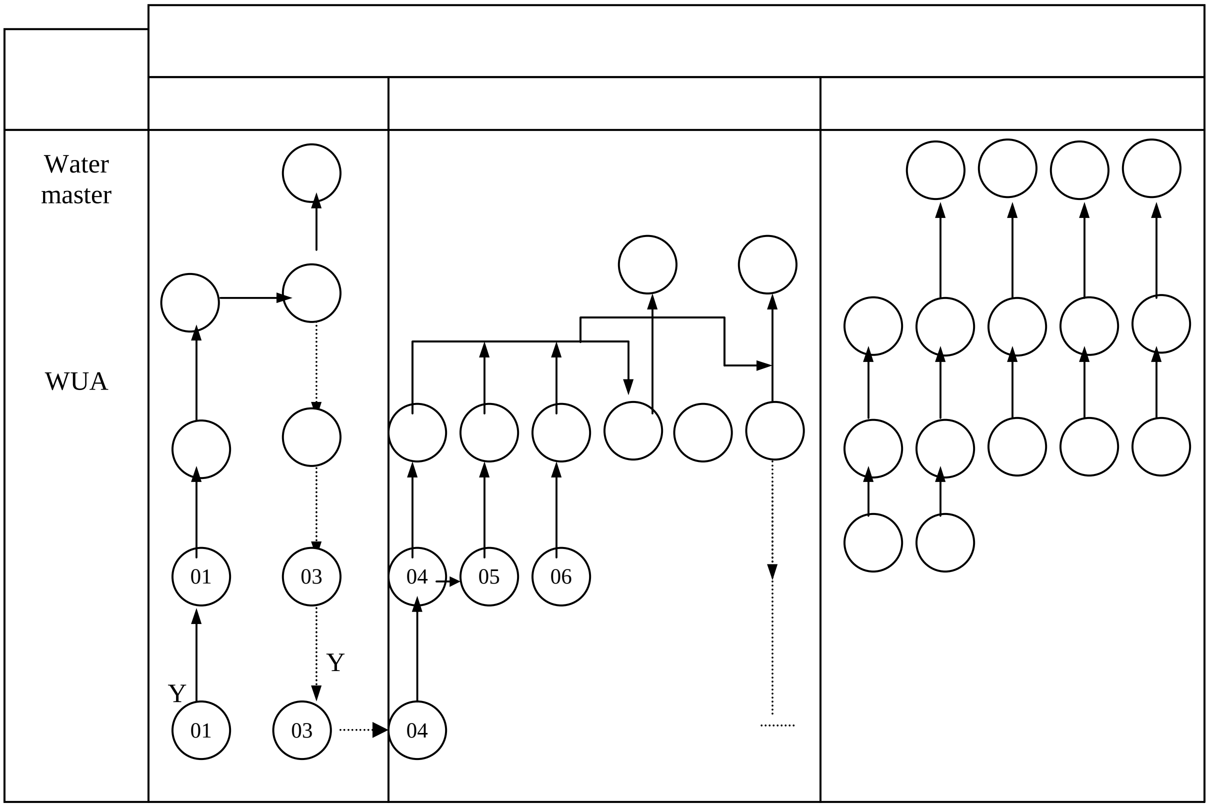
In O-form procedures, farmers only participate in the determination of cropping pattern by providing information about their crops and planned planting area for the next planting year. On the contrary, government officials conduct other activities including determination of the amount of water delivered to tertiary off takes.

Maintenance Procedure

The maintenance procedure using the P-form, as shown in figure 2.1.2. consists of incidental maintenance, routine maintenance and heavy maintenance. Incidental maintenance takes place when a structure in irrigation system is destroyed due to natural disaster or human error. The report on incidental maintenance (O3-P form) goes directly from system level to provincial level and is considered as an emergency report. T he routine maintenance, including activities such as lubrication of gates and canal cleaning, follows the procedure of planning and implemented by the Irrigation Department at district level to provincial level (04-P form).

The heavy maintenance consists of two types of work, namely self-managed and contracted work. District officials in the Irrigation Department conduct the self-managed works. The plan (07-P form) is formulated at the district irrigation department and reported to provincial level. A private contractor conducts the contracted works planned by the district irrigation department (08-P form) and reported to the provincial level (10-P form).

Figure 2.2.1. Operational procedure of an irrigation system



Form		Form		Form	
No	Explanation	No	Explanation	No	Explanation
01	Planting plan in tertiary level	04	Tertiary planting area	10	Flood river discharge
		05	Permitted planting area	11	Rainfall data
02	Planting plan in water master level	06	Measured discherge	12	Yearly rainfall data
03	Global planting plan	07	Irrigation water requirement	13	Yearly river discharge data
		08	River (source) discharge	14	Scheme crop data
		09	K-factor determination	15	Seasonal planting area
				16	Yearly planting area

Notes:

→ : info direction

- - -→ : feedback direction

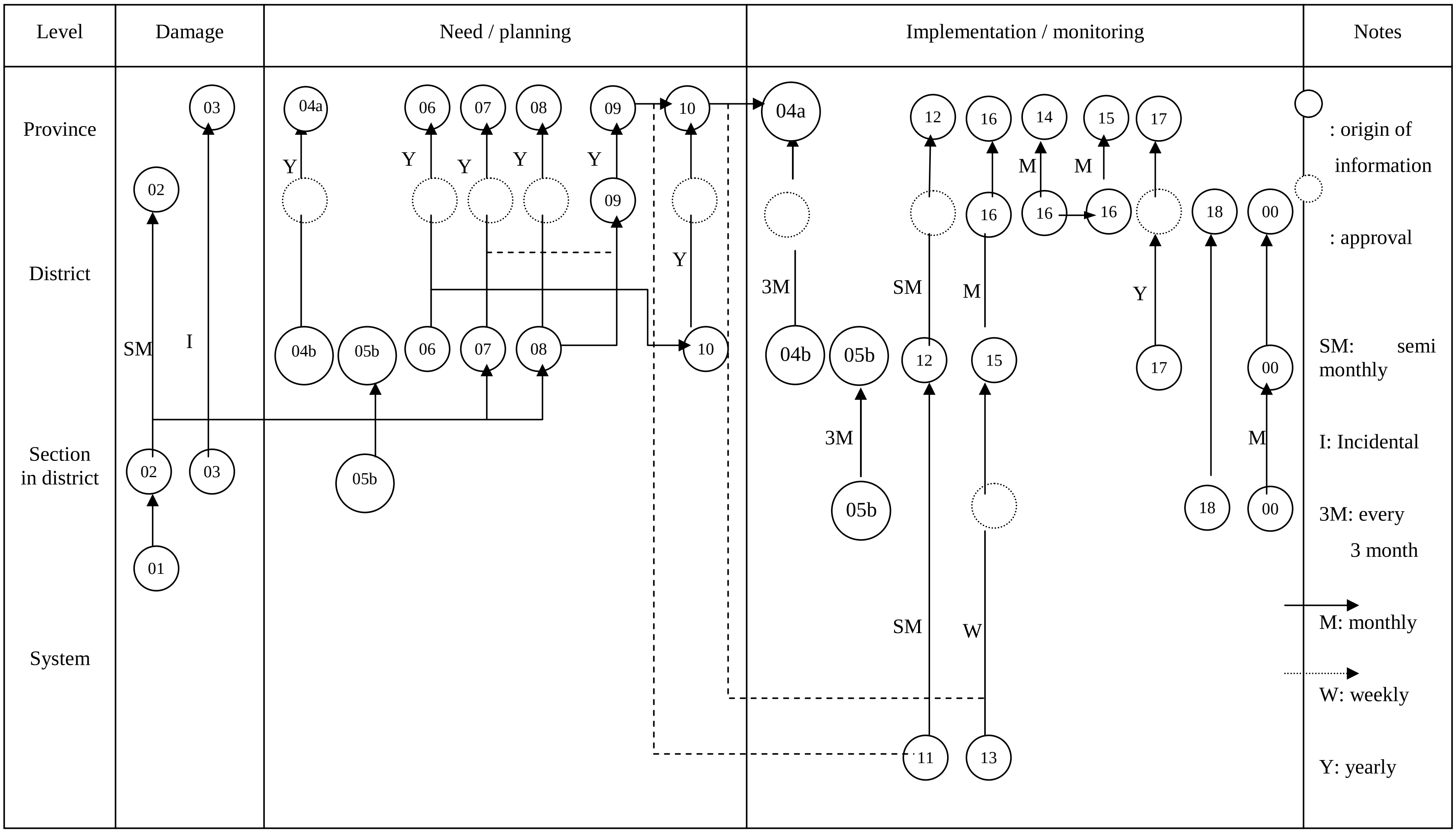
Y : yearly

S : seasonally

SM : semi-monthly

M : monthly

Figure 2.2.2. Maintenance procedure of an irrigation system



Form No.	Explanation	Form No.	Explanation
00 – P	Report of maintenance	08 – P	Priority scale of temporary contracted maintenance
01 – P	Report of scheme damage and irrigation facility report	09 – P	The self-managed program
02 – P	Report of scheme damage and irrigation facility report	10 – P	The temporary contracted program
03 – P	Report of natural disaster damage/emergency	11 – P	Implementation of temporary self-managed works
04 – P	List of paint and lubricant of control structure	12 – P	Implementing of temporary self-managed working
	a) Planning	13 – P	Weekly contracted progress report
	b) Implementation	14 – P	Monthly monitoring: inspection of self-managed material
05 – P	List of payment and material stock	15 – P	The use of self-managed material
06 – P	Report of measuring and scheme maintenance and irrigation facility	16 – P	Monthly report: realization of temporary contracted work
		17 – P	Monthly report: realization of maintenance
07 – P	Priority scale of self-managed maintenance	18 – P	Monthly monitoring: use of paint and lubricant of big control structures

2.3. IRRIGATION MANAGEMENT POLICY REFORMS

Paradigm Shift in Irrigation Management

During the initial period of the new-order government, irrigation development was carried out to solve the problem of food shortages and to achieve self-sufficiency in rice. Therefore, the government applied three strategies in irrigation development, i.e., infrastructural development, incentive to farmers and institutional development (Affif 1992). Approaches to irrigation development were a) target-oriented physical development, b) engineering approach based on engineering economy basis, c) centralist approach, and d) uniform method throughout the country. Through these approaches, irrigated areas were expanded significantly. For example, expansion in irrigated rice areas had reached 4 million hectares by 1990, with half of this area located in Java. The above approach helped achieve self-sufficiency in rice, but was not necessarily successful in improving the welfare of farmers. It was realized that the engineering and centralistic approaches were not appropriate. In the middle of the 1980s, the participatory development model, which emphasized community involvement and learning process, was emphasized (Soedjatmoko 1987; Korten 1987; Chambers 1987). Also, the government faced difficulty in providing funds for system O&M. In 1987, the Government of Indonesia set out a policy statement on the management of irrigation systems. This policy relates to efficiency in O&M and recovery of O&M cost from the beneficiaries. Components of this policy are: Need-Based Budget (NBB), Irrigation Service Fee (ISF), Turnover Program (PIK), Efficient O&M (EOM), Programming and Monitoring System (PMS), Integrated Water Resources Management (WRM), Project Benefit, Monitoring and Evaluation (PBME) and Cost Effectiveness, Rehabilitation and Modernization of Irrigation Schemes research study. ISF is a program applied to large irrigation systems (command area 500 ha or more) to introduce a charge to water users, which reflects the cost of providing the irrigation service in the course of implementation. For smaller irrigation systems (serving areas less than 500 ha) PIK was implemented with the aim to ultimately turnover all small irrigation schemes. The program involves the transfer of responsibility from the government agency to Water User Associations (WUAs). Emphasis is on improving governance (transparency, accountability, equity, efficiency, effectiveness, responsiveness and participation) in the water sector.

In 1999, the Government of Indonesia launched a reform program in the water resources sector including for irrigation management, through Presidential Instruction No. 3/1999 and the Government Regulation No. 77/2001. Key elements of reform on irrigation management policy include a) redefinition of the role and responsibility of irrigation management institution; b) empowerment of WUAs; c) irrigation management transfer; d) ISF; and (5) sustainability of irrigation systems. Table 2.3.1 provides differences between GR 23/1982 and GR 77/2001.

Table 2.3.1. Differences of characteristics between GR No. 23/1982 and GR No. 77/2001.

Basic characteristics	GR No. 23/1982	GR No. 77/2001
Goal	Regulation on provision of infrastructure to support rice self-sufficiency	Regulation on infrastructure to increase farmers' income and to achieve farmers' welfare
Suitability of goal in irrigation as a nested system	Second nest (irrigated agriculture system) to fulfill rice self-sufficiency in the fifth nest directly	Third nest (agricultural economy system) or fourth nest (rural development system)
Management principle	Monocentrism or single authority; the government dominates the management	Polycentrism, society has the right to manage
Driving force	Land productivity	Market
Constraint	Climate and water availability	Capital and product quality
Leading sector	Ministry of Public Works	National planning body (Bappenas) and Regional planning body (Bappeda)

Policy 1. Redefinition of the Role and Responsibility of Irrigation Management Institution

The transformation of the role and responsibility of irrigation management institutions is regulated in Law No. 22/1999, Government Regulation No. 25/2000, and Government Regulation No. 77/2001. However, there are some problems in implementation of this policy principle. First, dynamics in society demands institutions for irrigation management as rules in use. This is based on the reality that irrigation management is actually a management of common pool resource, which follows polycentrism. Second, the demand for water rights has emerged. The water right is sometimes misinterpreted as right of water allocation that water belongs to the government as the responsible faction. The responsibility consists of provision and management. In the past, both of them were carried out by one department. Third, the present institution may be incompatible with the new regulation, namely GR No. 77/2001. The present institution was developed based on GR No. 23/1982 with the aim of rice self-sufficiency. Fourth, the reorganization should be done by a participatory approach. Only a few people understand that irrigation is a sociocultural system while the principle is essential for present irrigation management. Last, it is required to formulate local regulation at regional level to regulate the implementation of national-level laws. The local regulation is important to guide irrigation management in each region. The formulation of local regulation should consider democratization and involves all stakeholders. It should also refer to diversity of local characteristics and socioculture of the people.

Policy 2. Empowerment of WUAs

Empowerment should be defined as a process to develop and strengthen the peoples' ability to provide benefit continually in a dynamic process in a responsible way (Fetterman 1996; Rees 1991; Brown 1994). In this policy, the government realizes the importance of the WUAs in irrigation management and, therefore, considers WUAs as an important socioeconomic institution with an authority to manage irrigation systems. Furthermore, the government considers that efforts to empower WUAs should be based on certain principles: democratic, transparent, consistent, accountable, partnership, and based on local resources (Adinugroho 2001). The indicators of WUA empowerment are appropriate capability on technique and finance. Different from the previous uniform approach, the WUA empowerment should be done based on the diversity of local characteristics. Therefore, the local government should have vision on local characteristics, problems, and its environment.

Policy 3. Irrigation Management Transfer

Irrigation Management Transfer (IMT) is basically implementation of the above two policy principles. IMT is an approach to empower people by transferring the management of an irrigation system at all levels. IMT should be implemented democratically and transparently, so that people realize benefits from managing their own systems. The IMT program under this policy is different from the previous turnover programs for small-scale irrigation system (PIK). The PIK considered participation as mobilization efforts while IMT under this policy considers participation as an empowerment effort. PIK was implemented to reduce O&M budget of the government whereas the objectives of IMT are manyfold, with the core being empowerment of people. Last, under PIK, irrigation assets were turned over to WUAs while for IMT under the new policy still belongs to the government. Consequently, IMT implementation does not mean that the government terminates its responsibility in O&M of an irrigation system. The government has responsibility to facilitate people so that they are capable of managing their irrigation systems. By empowering with IMT implementation, it is expected that the O&M budget will decrease gradually. In order to be successful, IMT should be implemented gradually as a learning process. Implementation of IMT with a big bang should be avoided. This is important in view of farmers' capacity to take over management responsibilities.

Policy 4. Irrigation Service Fee (ISF)

The policy on ISF aims to provide funding for O&M of an irrigation system. It does not aim to burden farmers with additional fees but aims to empower farmer institutions so that they have the capacity to manage irrigation systems independently. The keys to success of this policy are simple procedures on fee collection, transparency and accountability of fund management, as well as transparency in ISF payments. In accordance with the diversity principle, the procedure of ISF collection and management is developed by each district.

Policy 5. Sustainability of Irrigation Systems

The policy on sustainability of irrigation systems clearly indicates prevention of land conversion from agriculture to other uses and sustainable use of water resources. The unsustainability of an irrigation system is caused not only by land conversion but also by other factors including social, economic and environmental factors (Arif et al. 1998, 1999, 2000). The physical sustainability of the irrigation system is important as it is related to its functions in the hydrologic cycle. In some cases, the district government ignores this function. Because unsustainability in social and economic factors may lead to physical unsustainability of the system, empowerment of society to manage their irrigation systems becomes important. The empowerment is expected to generate independent WUAs with comparative and competitive advantage to improve sustainability of the systems.

Implementation of New Policy

Understanding the meaning of the reform on irrigation management policy is expected to give a basis to develop a comprehensive strategy to implement it. An irrigation system functions not only as a food provider but also as a support for tradable commodities. Therefore, the characteristic of irrigation shifts from protective irrigation to productive irrigation (Pusposutardjo 1999). The difference between protective irrigation and productive irrigation is shown in table 2.3.2.

Table 2.3.2. Characteristics of productive and protective irrigation (Pusposutardjo 1999).

No.	Descriptor	Protective irrigation	Productive irrigation
1.	Objective	To protect crops from water insufficiency due to climate change	Optimum water sufficiency for cultivation
2.	Basic management principles	Uniformity of water distribution throughout the command area	Productivity value of land- received irrigation water
3.	Cultivated crop	Food crops as a part of subsistence farming	Tradable crops demanded by the market
4.	Product orientation	Certainty on farming system	Optimal production with financial benefit
5.	Water status	Water as an input to protect production crops	Water as a capital of farming system
6.	Expected management system	Distribution of water	Water supply with optimum productivity of the farming system
7.	Irrigation system network	Good irrigation system	System of supply, distribution, and control of water shortage and excessive water

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Part — 3

Country Study: An Analysis for Strategic Interventions

PART 3

Country Study: An Analysis for Strategic Interventions

3.1 INTRODUCTION

As explained in part one of the report, the overall goal of the study is to promote and catalyze equitable economic growth in rural areas through pro-poor irrigation interventions. The immediate objective is to determine what could realistically be done to improve the returns to poor farm households in the low-productivity irrigated areas. The study focused on selected representative irrigation systems in Central Java and Yogyakarta province with a large number of people under persistent poverty. The emphasis is on identifying and assessing a set of appropriate economic, financial, institutional and technical interventions at field and system levels, and changes in overall policy and institutional framework as far as they affect access of the poor to water resources and their productivity levels. The study is based on primary data collected at the system and household levels, supplemented with secondary data where necessary.

This part of the report provides details on selected study areas, data, analysis, results, findings and conclusions of the study. This part is divided into eight sections. Section 1 presents details on study settings, data collection procedures, and characteristics of selected systems and sample households. Sections 2 and 3 provide analyses of poverty, including spatial dimensions of poverty, characteristics of the poor and key determinants of poverty in irrigated areas. Section 4 assesses performance of selected irrigation systems and associated impacts on poverty. Section 5 identifies key constraints to enhancing crop productivity in the studied systems. Productivity and poverty impacts of recent institutional interventions are assessed in section 6. Based on the above, section 7 presents a detailed analysis of constraints and opportunities for reducing poverty in irrigated agriculture. The last section provides a summary of key study findings, main conclusions and recommendations.

3.2. STUDY SETTINGS AND DATA

Poverty Profile

Irrigated areas of selected irrigation systems are parts of Demak, Grobogan, Magelang, and Kulonprogo regencies. Based on secondary data in 1999, socioeconomic conditions of the regencies are presented in table 3.2.1.

Table 3.2.1. Socioeconomic aspect in selected regency.

No.	Description	Demak	Grobogan	Magelang	Kulonprogo
1	Area (ha)	89,743	197,585	108,573	58,627
2	Number of villages	247	280	369	88
3	Rice field area (ha)	51,064	62,115	37,673	11,145
4	Percentage rice field area to land area (%)	56.90	31.44	34.70	19.01
5	Technical irrigated area (ha)	17,113	17,725	6,928	6,767
6	Percentage of technical irrigation to wetland area	33.51	28.53	18.39	60.72
7	Wetland - rice yield rate (ton/ha)	4.98	4.55	5.01	5.45
8	Population density (person/km^2)	1,048	628	973	752
9	Number of households	236,569	333,099	274,812	89,386
10	Percentage of worker in agriculture to population	21.74	29.08	25.49	29.82
11	Percentage of poor people from population	22.16	37.23	30.15	35.17
12	Percentage of Pre-Prosperous family to household	56.36	70.79	47.56	41.68

Source: Central Java in figure, 1999 and Yogyakarta in figure, 1999.

Poverty exists in irrigated agriculture, and is influenced by the following major factors.

1. Landownership: Land size is generally small (less than 0.5 hectare) and landlessness is common and increasing. Land fragmentation due to inheritance system results in reducing the landholding per household, with small pieces of land generally uneconomical and farmers losing interest in farming. Farmers are gradually moving towards nonagricultural activities.
2. Access to production factors: Farmers have limited access to information, water, capital and technology. Mostly rich farmers take advantage of the modern agricultural technology. Extension services and access to credit, especially from the public-sector institutions, are also limited and not favorable to the poor.
3. Marketing: Information on input and product market alternatives is limited. Normally, traders do not buy rice from farmers at the floor price set by the government. As a result, market intermediaries make money and farmers lose profits.

4. Uncertain income in the agriculture sector: Uncertainty occurs when the crops get pests and diseases or there is overproduction.

Irrigated Agriculture Profile

Central Java and Yogyakarta Special Region lie in Java, a very populous island. Java Island is the center of the Government of Indonesia. In Java, the development of infrastructure, education and population is fast. Many impacts arise from its fast development. One of those is land conversion as shown in table 3.2.2, which indicates that during the 10 year period cultivated area in Yogyakarta had been reduced by 2.9 percent and forest cover in Central Java by 5.3 percent.

Table 3.2.2. Land use in Yogyakarta Special Region and Central Java Provinces.

	Unit	Yogyakarta		Central Java	
		2000	1990	2000	1990
Cultivated area	ha	199,323	205,203	1,928,293	1,921,540
Urban land area	ha	45,580	46,700	268,035	235,300
Grassland/Savannah	ha	0	0	2,699	4,215
Forest cover	ha	17,181	15,775	552,964	584,009
Irrigated land area	ha	50,217	52,377	720,390	649,095
Irrigated area /Total arable area	%	25.19	25.26	29.03	25.91

Sources:

1. Agricultural Survey: Land Area by Utilization in Indonesia 2001, BPS, Jakarta.
2. Agricultural Survey: Land Area by Utilization in Indonesia 1991, BPS, Jakarta.
3. Statistical Year Book of Indonesia 1991, BPS, Jakarta.
4. Statistical Year Book of Indonesia 2001, BPS, Jakarta.

The additional cultivated and irrigated area in Central Java suggests that Central Java government has made efforts to boost agricultural production. However, primary water supply is only about 40 percent of potentially utilizable water (National Research Council 1994), constraining agricultural development. The addition of irrigated agricultural land area, urban land area, and cultivated area in Central Java must be actuated in a proper way. Improving agricultural production by means of extension and settlement construction would, hopefully, not destroy the environment. The forest cover reduction as catchment area in Central Java in the long term, however, will have some impacts on water supply. Overall primary water supply is far from sufficient.

Since Yogyakarta and Central Java are located in the same territory, their primary water supplies are fairly similar. According to National Research Council (1994), in Yogyakarta, primary water supply is about 31.17 percent of potentially utilizable water. The irrigated cropping areas of the two provinces are also similar, i.e., 41.08 percent and 31.76 percent of total cropping area for Central Java and Yogyakarta, respectively. There is competition for agricultural water use, and sometime conflict is inevitable.

Meso Level Irrigation Law

As per the new laws and GRs, irrigation management is under the administration of Provincial and District Governments. Except for cross border irrigation system management that is still under Provincial Government, almost all the assets of irrigation infrastructures and their management are under District Government administration. The centralistic power no longer exists, and there is a decentralization and participatory approach. According to this approach, Provincial Governments have three other authorities and responsibilities, i.e. a) deciding agricultural policy and irrigation water requirement, b) standardizing implementation of O&M procedure, c) facilitating O&M implementation in the province, and d) providing technical assistance and financial support if necessary.

The law at provincial and regency level is for implementation of higher-level law at the national level. Some provinces and regencies have developed regulations on irrigation with the implementation of GR No 77/2001. The Province of Central Java and Yogyakarta Special Region are still under discussion in the parliament for Provincial Regulation (PR) on Irrigation. Drafts of the PR for both provinces are already through and are being discussed in the parliament. The situation is the same for District Demak and Grobogan Regencies where regulation is still under preparation. However, in Kulonprogo and Magelang Regencies, the Regency Regulation on irrigation has already been issued. This Regency Regulation is being used to implement a new concept of irrigation management. Participatory Irrigation Management through IMT has already been implemented in these regencies. All irrigation systems in Kulonprogo have been transferred to farmers starting from year 2000. In Magelang more than 3,000 hectares of irrigated area that cover five irrigation systems have already been transferred to farmers. The Krogowanan irrigation system has been transferred since the year 2000, which is a pilot project of IMT with World Bank Project funds.

Location

A detailed study was conducted in four irrigation systems in Java, namely Kalibawang, Krogowanan, Klambu Kiri and Glapan. The location of Java Island in Indonesia is shown in figure 3.2.1 while figure 3.2.2 shows the location of selected irrigation systems in Java. Administratively, Kalibawang system is located in Yogyakarta Special Province while Krogowanan, Klambu Kiri and Glapan are situated in Central Java Province.

Figure 3.2.1. Location of Java Island in Indonesia.

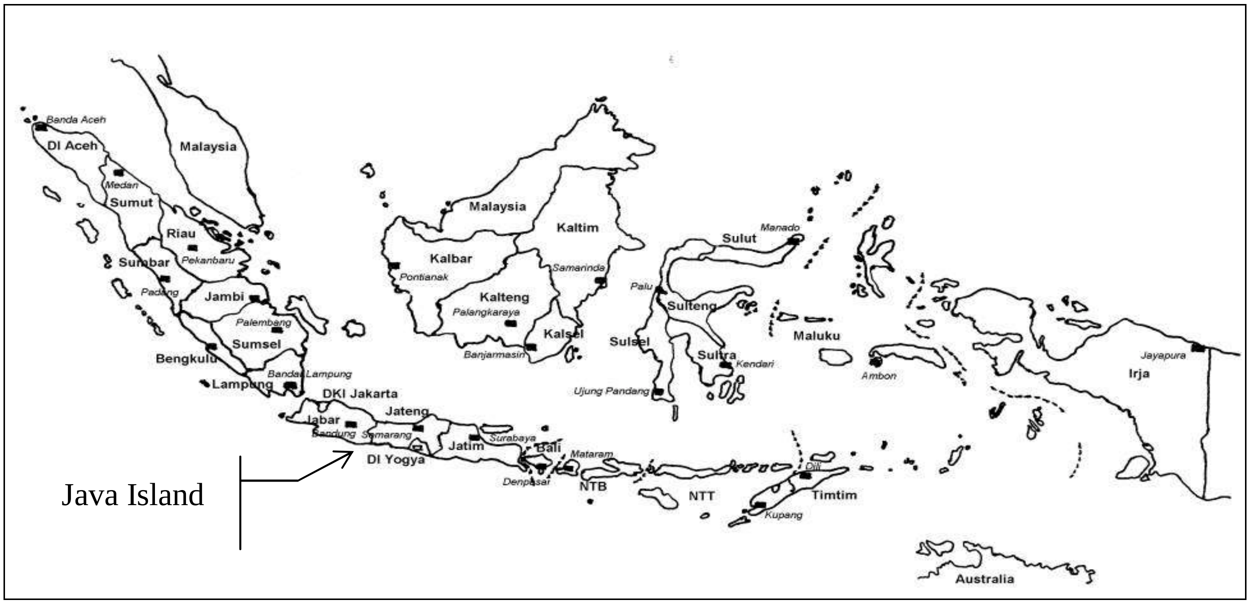
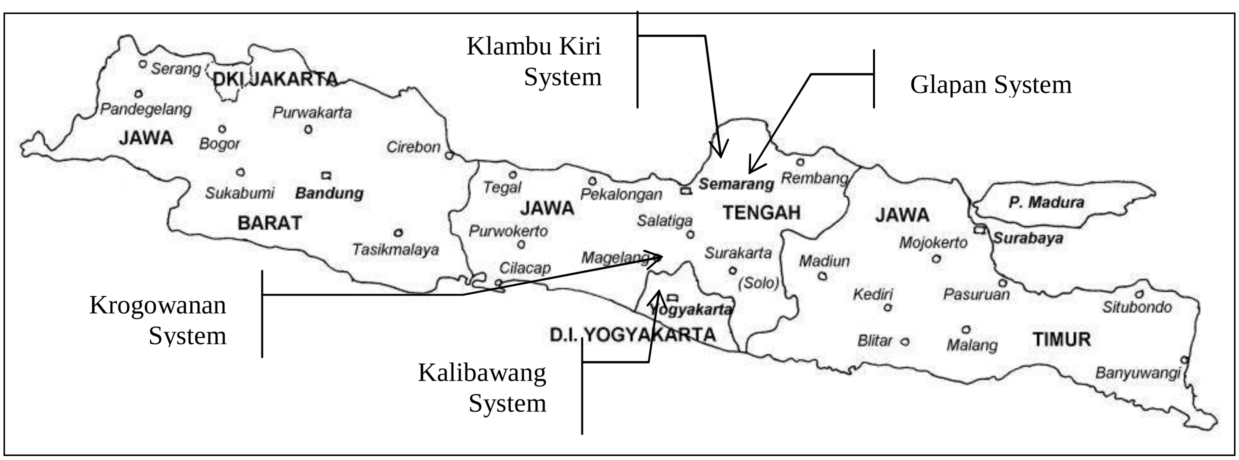


Figure 3.2.2. Location of selected irrigation system.



Central Java has an important role in producing food to the country since it has a relatively large area under irrigation, estimated at 1,002,306 hectares (30.84%). Although Yogyakarta is a small province in Java, irrigation management in this province is unique because it operates based on a reuse water system. In this system, drainage water from the irrigation system is then used in another downstream irrigation system. Yogyakarta is also unique in the sense that it is a kingdom that is still governed by a Sultan as the emperor of the province. This has effects on the local government and the socioculture of the people in the province. These two provinces have a relatively large number of people dispersed in several districts under the poverty line. In terms of poverty, Kulonprogo is one of the poorest districts in Yogyakarta Special Province with a relatively large area under irrigation. In Central Java, Demak is one of the poorest districts in the province, despite which it has a relatively large area of irrigated agriculture.

Physical Characteristics

Hydrology

The Kalibawang system is the largest irrigation system in Kulonprogo Regency. The system consists of five irrigation schemes namely Kalibawang, Penjalin, Papah, Pengasih and Pekik Jamal. IMT program, under the new irrigation management policy, has been implemented in Papah and Pengasih irrigation schemes in 1999 and later in Kalibawang and Pekik Jamal in 2002. Three out of five irrigation schemes in Kalibawang system are selected as sample sites for this study, namely, Kalibawang, Pengasih and Pekik Jamal schemes to represent head, middle, and tail reaches of the systems, respectively.

Two major rivers dominate the hydrology of Yogyakarta Special Province, Progo river to the West and Opak river, which flow below the escarpment of the Wonosari Plateau to the East. Most of the irrigated area in Yogyakarta Special Province lies to the South of Mataram canal that transfers flow eastward from the Progo river, via the northern suburb of Yogyakarta, eventually draining to the Opak river. This canal, which is about 30 km long, supplies the Van der Wijck scheme (5,000 ha) and allows the flow in 12 smaller rivers to be supplemented. These in turn supply a large number of small irrigation systems amounting to a total of about 24,300 ha.

While Mataram canal serves the left bank of the Progo river, the right bank is served by the Kalibawang canal. Along the Kalibawang Primary canal water is diverted into several tertiary blocks under the Kalibawang Irrigation Scheme (1,525 ha). At the end of the Kalibawang primary canal, water is diverted into two directions. To the left it supplies the Donomulyo secondary canal as well as the Papah river and to the right it supplies the Serang river. Furthermore, Penjalin (652 ha) and Papah (983 ha) irrigation schemes divert water from the Papah river while Pengasih (2075 ha) and Pekik Jamal (739 ha) divert water from the Serang river.

In Central Java the IMT program was implemented in two schemes, i.e., Krogowanan (832 ha) irrigation scheme in Magelang Regency and Beton irrigation scheme in Wonogiri Regency. For the following phase, Pasekan (847 ha), Kojor Semendi (810 ha), Sidandang (612 ha), and Balong Kaliaji (522 ha) systems were transferred through an IMT program in 2001.

The Magelang Regency in Central Java lies among three mountains, i.e., Mount Merapi and Merbabu to the East and Mount Sindoro to the West. The Progo river flows from North to South in the middle of the regency. Among several Progo tributaries are the Pabelan, Kunjang and Klesem rivers. They become the main water source of the Krogowanan system. Krogowanan (832 ha) is an interconnected irrigation system diverting water from several weirs and springs. It diverts water from the Pabelan river through 3 weirs, i.e., Krogowanan, Banyusumurup, and Surodadi weirs. Water from the Klesem river is diverted through Guwo, Kamal, Kendil Wesi, Karang Winong and Bangkong weirs while water from the Kunjang river is diverted through Kunjang and Pace weirs. The Krogowanan system receives water from four springs, i.e., Udal, Mudal, Semaren and Gung springs.

Almost all irrigated areas in Demak Regency are located in the Jratunseluna river basin. Jratunseluna consists of five main rivers namely Jragung, Tuntang, Serang, Lusi, and Juana. In the upper part of the Serang river, Kedung Ombo reservoir was developed in 1987.

The Klambu weir is situated in the Serang river, where water is supplied from the Kedung Ombo reservoir. It was constructed at the time when Kedung Ombo reservoir was developed. Klambu has a command area of 48,715 hectares divided into two irrigation schemes namely Klambu Kiri (Left Klambu: 21,457 ha) and Klambu Kanan (Right Klambu: 27,258 ha). The Wulan and Jajar rivers are confined to command area of Klambu Kiri, which is selected as the sample scheme for this study.

The Glapan weir diverts water from the Tuntang river, which originates from the Rawa Pening lake. The weir is located in the Glapan village, Grobogan Regency. The command area of Glapan scheme is divided into Glapan Timur (East Glapan: 8,671 ha) and Glapan Barat (West Glapan: 10,113 ha).

Climate

The general climatic condition in Central Java and Yogyakarta falls under the category of the tropical monsoonal climate. It is influenced primarily by the seasonal monsoons, namely the Southeast (SE) and Northwest (NW) monsoons. The SE monsoon creates the dry season, normally from the middle of May to October. The characteristics of this period are a less amount of rainfall, lower humidity and less cloudiness. The NW monsoon creates the rainy season, generally taking place from November to April. It is the period of frequent and heavy rainfall, high relative humidity and cloudiness. More than 80 percent of annual rainfall falls in this period.
Climatic parameters were taken from the record of the closest weather station to the system. Yogyakarta and Borobudur weather stations represent the climatic condition of Kalibawang system and Krogowanan system, respectively. The climatic condition of Klambu Kiri and Glapan is represented by the Semarang weather station. The average monthly value of climatic element of the study area is presented in tables 3.2.3 to 3.2.5.

Table 3.2.3. Monthly climate of the Yogyakarta weather station.

Month	Minimum temperature (^oC)	Minimum temperature (^oC)	Relative humidity (%)	Wind speed (km/day)	Sun shine duration (%)	Rainfall (mm)
January	23.78	30.53	86.11	205.22	41.56	358
February	23.73	30.73	86.56	185.67	43.22	390
March	20.32	31.28	84.67	187.78	43.56	294
April	23.92	31.73	85.56	195.78	51.56	209
.May	23.98	32.05	82.22	158.89	54.11	53
June	23.23	31.67	82.44	158.11	50.33	52
July	22.02	31.30	82.78	179.11	57.56	43
August	22.28	31.55	69.44	166.67	48.00	9
September	19.55	32.52	68.67	216.89	50.11	5
October	24.15	32.45	71.67	184.00	42.22	144
November	24.25	31.00	74.78	183.00	37.78	248
December	23.97	30.40	73.78	223.11	41.00	341
Year	22.93	31.43	79.06	187.02	46.75	2,147

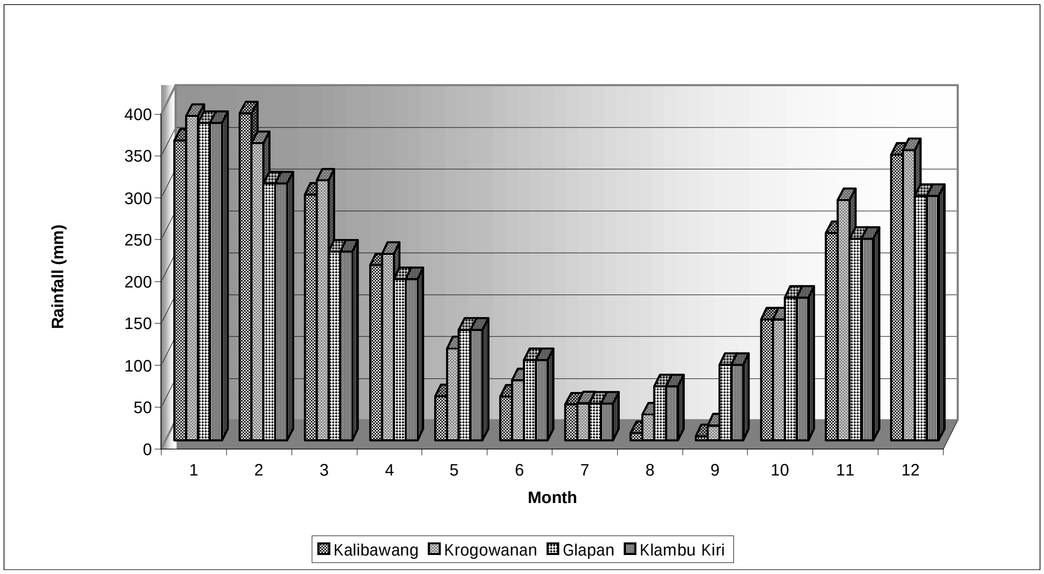
Table 3.2.4. Monthly climate of the Borobudur weather station.

Month	Minimum temperature (^oC)	Minimum temperature (^oC)	Relative humidity (%)	Wind speed (km/day)	Sunshine duration (%)	Rainfall (mm)
January	20.56	32.69	83.62	55.85	36.62	388
February	20.49	32.96	83.00	57.00	39.69	355
March	20.58	33.22	82.69	53.46	51.38	311
April	20.41	33.03	82.54	50.00	55.08	223
May	18.87	33.14	80.23	58.15	75.00	110
June	17.96	32.86	80.00	58.69	70.77	72
July	16.35	32.80	76.92	71.85	75.38	45
August	14.62	30.77	69.46	83.77	69.85	31
September	15.78	31.46	66.92	111.77	66.77	18
October	17.88	31.73	70.00	85.85	54.38	144
November	19.02	31.25	74.38	64.54	43.46	287
December	18.85	30.43	75.46	61.38	44.46	347
Year	18.45	32.19	77.10	67.69	56.90	2330

Table 3.2.5. Monthly climate of the Semarang weather station.

Month	Minimum temperature (^oC)	Minimum temperature (^oC)	Relative humidity (%)	Wind speed (km/day)	Sunshine duration (%)	Rainfall (mm)
January	23.64	30.58	83.46	285.67	51.55	379
February	23.72	30.55	72.55	248.46	55.65	307
March	23.97	31.38	81.80	247.35	54.08	226
April	24.45	32.14	77.77	230.46	65.65	193
May	24.59	32.92	75.15	248.91	76.94	132
June	23.87	32.66	73.41	231.17	76.98	96
July	23.13	32.72	71.88	246.24	65.33	44
August	21.35	29.92	69.88	214.68	98.27	65
September	21.14	30.46	61.06	238.69	65.85	90
October	21.67	29.90	66.71	222.68	55.63	170
November	24.05	32.21	76.67	221.80	51.37	241
December	23.84	31.08	81.31	237.35	46.49	292
Year	23.28	31.38	74.30	239.46	63.65	2,234

Figure 3.2.3 Average monthly rainfall in selected areas.



Rainfall is distributed unevenly throughout the year. The records of mean annual rainfall in Yogyakarta, Borobudur and Semarang weather stations are 2,330 mm, 2,147 mm, and 2,234 mm, respectively. The average monthly rainfall pattern at the three selected rainfall stations is shown in figure 3.2.3. This figure shows that the rainfall in the three selected stations follows the same pattern with only small differences. The pattern follows the general SE-NW monsoonal pattern.

The climatic parameters recorded at the three weather stations vary insignificantly. The average of maximum temperature compiled at the Yogyakarta weather station varies from 30.4 ^{o}C in December to 32.5 ^{o}C in September while the average minimum temperature varies from 19.6 ^{o}C in September to 24.2 ^{o}C in November. The mean monthly relative humidity varies from a minimum of 69 percent in September to a maximum 87 percent in February. The mean monthly wind speed at the Yogyakarta weather station varies from 158 km/day in June to 223 km/day in December. The wind generally follows the monsoonal wind direction. In addition, the sunshine duration ranges from 38 percent in November to 58 percent in July.

The average maximum temperature compiled at the Borobudur weather station varies from 30.4 ^{o}C in December to 33.2 ^{o}C in March while the average minimum temperature varies from 14.6 ^{o}C in August to 20.6 ^{o}C in March. The mean monthly relative humidity varies from a minimum of 67 percent in September to a maximum of 84 percent in January. The mean monthly wind speed ranges from 50 km/day in April to 112 km/day in September. In addition, the sunshine duration ranges from 37 percent in January to 75 percent in July.

The climatic parameters recorded at the Semarang weather station are similar to those recorded at the other weather station. The average maximum temperature compiled in this station varies from 29.9 ^{o}C in October to 32.9 ^{o}C in May while the average minimum temperature varies from 21.1 ^{o}C in September to 24.6 ^{o}C May. The mean monthly relative humidity varies from minimum of 61 percent in September to a maximum of 83 percent in January. The mean monthly wind speed at the Semarang weather station varies from 215 km/day in August to 286 km/day in January. The sunshine duration ranges from 46 percent in December to 98 percent in August.

Cropping Pattern

Because rainfall is an important source of water for agriculture, its distribution throughout the year is the main factor that affects cropping patterns. At the beginning of the rainy season, generally in October/November farmers start the first planting season called the rainy season (RS). During RS, rice becomes the dominant crop because it can adapt to the excessive water in the rainy season.

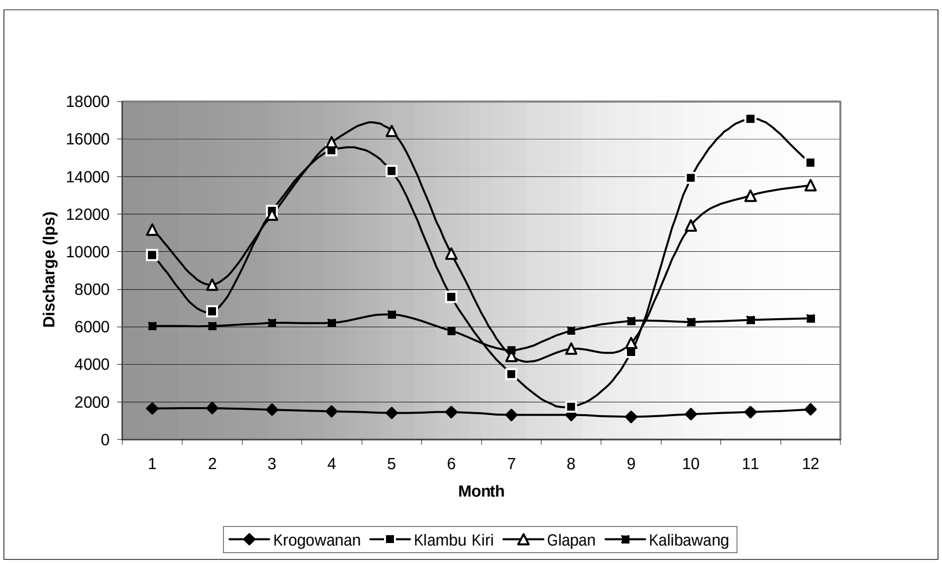
Following harvesting time of RS crops the rainy season comes to an end. At the time when rainfall is getting less in February or March, farmers start growing the second crop. This season is called Dry Season 1 (DS 1). In the area where irrigation supply is ensured to fulfill deficiency of crop water requirement when rainfall is inadequate, farmers generally grow rice; otherwise, they grow other crops that need less water.

Dry Season 2 (DS 2) starts in June or July following DS 1. In this season, generally, farmers grow upland crops (*palawija*), for example maize, mungbean, or soybean that is more tolerable to the condition of less water. When soil, temperature, elevation and other factors are suitable vegetables are grown. These are the most common cropping patterns practiced in Java.

Discharge

Discharge measured at the main intake of the selected systems is depicted in figure 3.2.4. Generally, the main intake discharge follows the fluctuation of rainfall with some adjustment to the irrigation water requirement.

Figure 3.2.4. Average monthly discharge at main intake at selected systems



The discharge at Klambu Kiri varies widely from 1,000 lps to 17,000 lps. Likewise in the Glapan system, the discharge varies from 4,000 lps to 17,000 lps. In the two systems, peak discharge occurs at the beginning of the first planting season because of high water demand for land preparation. At the end of the first planting season, the discharge is lower to anticipate harvesting of rice crops requiring less water. The lowest discharge occurs in the third planting season when upland crops become dominant and river discharge is also low.

In Kalibawang and Krogowanan systems, discharge varies from 5,000 lps to 7,000 lps and 1,000 lps to 2,000 lps, respectively. The fluctuation of the discharge mainly follows rainfall fluctuation. The highest discharge of Kalibawang takes place in May or in the second planting season when irrigation requirement is high and water is available in the river. In Krogowanan, the highest discharge takes place in January or February at the peak of the rainy season. On the other hand, the lowest discharge of Kalibawang and Krogowanan occurs at the peak of the dry season in July and August.

Soils

Soil is classified according to the USDA/Soil Taxonomy classification of 1994. Based on the soil survey, soil in the Kalibawang system is classified into two orders, namely, inceptisols and vertisols and three subgroups, namely, typic epiaquepts, aquic haplustepts and udic halpuderts. In the Kalibawang scheme, the soil falls under category typic epiaquents and typic epiaquepts while Pengasih and Pekik Jamal soils are classified as typic epiaquepts and udic hapluderts.

The soils in the Krogowanan system are classified as typic epiaquents and typic epiaquepts. The Glapan system soil falls under the category of typic haplusterts and the Klambu system soils are classified into two orders, namely, vertisols and inceptisols and two suborders, namely, typic haplusters and vertic epiaquepts.

Characteristics of soils in the selected area are presented in table 3.2.6. Due to the soil characteristics, the selected areas have several limiting factors to develop as agricultural areas.

Generally, the Kalibawang system suffers from most frequent limitations of low nutrient availability of macronutrients N, P and K. Farmers have to apply nonorganic fertilizers such as urea, TSP and NPK. Other common problems are limited organic matter and limited soil moisture availability.

In Krogowanan, soil texture is coarse and the structure is single grain or structureless; hence its infiltration rate is rapid and its water-holding capacity is low. This condition requires continuous water application for crops. The nutrient availability is also low for paddy, upland crops and vegetables.

In Glapan and Klambu Kiri, the soil has a high clay content and its structure is massive so that it is difficult to till the earth, especially in the dry season. Moreover, the soil is also sensitive to swelling and shrinkage. When soil moisture is very low, the soil shrinks and this condition is dangerous because this can make crop root cut. In addition, organic matter content and nutrient availability are low.

Table 3.2.6. Main soil characteristics in the study area.

System	Kalibawang						Krogowanan		Glapan	Klambu Kiri	
Scheme	Kalibawang		Pengasih		Pekik Jamal						
Soil Classification	Typic Epiaquents	Typic Epiaquepts	Typic Epiaquepts	Udic Hapluderts	Typic Epiaquepts	Udic Hapluderts	Typic Epiaquents	Typic Epiaquepts	Typic Epiaquepts	Typic Hapluderts	Vertic Epiaquepts
Physiographic	Lower river terrace	Middle river terrace	Alluvial plain	Alluvial plain	Mostly flat	Alluvial plain	Lower river terrace	Middle river terrace	Alluvium clay deposited	Alluvial clay deposited	Alluvial clay deposited
Slope	0 – 3 %	2 – 6 %	0 – 3 %	0 – 2 %	0 – 3 %	0 – 3 %	2 – 8 %	2 - 8 %	0 – 2 %	0 – 2 %	0 – 2 %
Soil depth	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100	> 100
Drainage	Poor	Somewhat poor	Poor to somewhat poor	Poor to somewhat poor	Poor	Poor to some-what poor	Poor	Moderate	Poor to some-what poor	poor	poor
Permeability	Slow to moderate	Slow to moderate	Slow to moderate	Very slow	Slow to moderate	Very slow	Moderate to rapid	Moderate to rapid	Moderate to rapid	very low	very low
Color	Dark gray brown to yellowish brown	Yellowish brown	Dark yellowish brown to dark brown	Dark gray	Dark yellowish brown to dark grayish brown	Gray to dark gray	Dark yellowish brown	Dark yellowish brown	Dark yellowish brown	gray to dark gray	gray to dark gray
Texture class	Sandy clay loam to silty loam	Silty loam to silty clay loam	Silty clay loam to loam	Clay	Silty clay loam to sandy clay loam	Silty clay to clay	Sandy loam to loamy sand	Sandy clay loam to silty clay loam	Sandy clay loam to silty clay loam	sandy clay to clay	silty clay to clay
pH	5,6-6,9	5,6-6,5	6,0-6,5	6,5-7,0	6,5-7,0	5,8-6,5	6,4-6,9		6,5-6,9	7,0-8,0	7,5-8,0
Organic matter	Low to medium	Low	Low	Low to medium	Medium to high	Medium	Low to medium	Low to medium	Low to medium	very low to low	low
Total nitrogen	Very low to low	Low to medium	Very low	Very low	Low	Very low	Low	Low	Low	very low to low	low
Available P_2O_5	Low to medium	Very low to low	Very low to low	Very low to low	Very low to low	Very low to low	Medium	Low to medium	Medium	low to medium	low to medium
Available K_2O	Low to medium	Low to medium	Low	Low to medium	Medium	Low	Low to medium	Low to medium	Medium	medium	low
CEC	Medium	Medium	Medium to high	High	Medium to high	High	Low	Low	Low	high to very high	high
Base saturation	Medium	Medium	medium	High	medium	High	Low	Low	Low	very high	high

Socio Economic and Poverty Characteristics

Primary data analysis shows clearly that all selected systems were characterized by a very limited size of landownership. An average landownership ranging between 0.2 and 0.3 hectare per household was reported to be the most serious constraint to agricultural production. The size of landownership was reported to be a more significant factor in causing poverty incidence at the micro level, though irrigation is also an important factor especially in the Glapan and Klambu Kiri systems, where there is a significant difference in agricultural performance at the head and the tail parts of irrigation systems. The cultural inheritance system has made fragmentation of landownership and operation unavoidable.

Significant consequences of limited landownership are, among others:

- Limited capacity of farmers in providing working capital.
- Limited access to farm credit.
- Un-bankable farming.
- Limited technology adoption.
- Subsistence-oriented farming.
- Being more-deeply trapped by rice farming.
- Limited capacity in adopting high-cost agricultural diversification.
- Limited market access of farmers.
- Getting more voiceless farmers.

The excellent environmental condition in Krogowanan was very conducive for crop diversification, while in the Kalibawang system, local institutions related to irrigation management were proved to be supportive in irrigated agricultural development. Effective improvement of the other systems, Klambu Kiri and Glapan, was constrained mainly by poor environmental conditions and limited capacity of local institutions in irrigation management.

Most of farmer respondent is land owner. It is more than number of sharecropper or rented land's farmer as shown in table 3.2.7.

Table 3.2.7. Percentage of owners, owner-cum tenants, tenants.

Irrigation system	Percentage of respondent		
	Landowner	Owner-cum tenant	Tenant
1. Kalibawang	83.20	2.80	14.00
2. Krogowanan	84.16	0.00	15.84
3. Klambu Kiri	73.00	1.67	25.33
4. Glapan	83.20	0.40	16.40

Source: Primary data 2002.

Formal and Informal Land and Water Rights

In 1960, the Law 5/1960 on Agrarian Reform (*Undang-undang Pokok Agraria, UUPA*) was set to regulate farmland. The law specifies a maximum limit of individual land held by territorial category. Some areas in Yogyakarta are classified as highly dense, and some areas in the suburbs of Central Java are classified as fairly dense. The maximum limit of individual landholding in the highly dense area is 15 hectares of rice field and 20 hectares of dryland, whereas in the fairly dense area the limit is 7.5 hectares of rice fields and 9 hectares of dryland.

In line with the changing human lifestyle, the size of agricultural land has been getting narrower. Agricultural land has been conversed for housing, industrial and infrastructural purposes. However, up to now no new law/institution has been set to regulate the size of agricultural landownership.

Although up to now the formal water-rights system has not been set up as yet, Law No. 5/1960 on Agrarian Reform states that the landowners have the right to the water sources over their own land. They also have the right to get water from a river, canal, or other water source outside their own land to irrigate their land for domestic and other uses.

In relation to water allocation within irrigation systems, two types of water rights, namely, riparian right and appropriation right are used (Arif et al. 1999; Roorda 2002). The riparian right gives more right to users closer to the water source. In irrigation systems, which apply the riparian right, farmers in the head reach have a higher priority in water allocation than farmers at the tail reach. Farmers at the tail reach generally have no objection when they get less water as long as it is adequate to prevent their crops from failure. Appropriation right means the first gets first service. In an irrigation system, people who initially developed the system had more right to water than others.

Most of the irrigation systems in Java applied riparian right in the past. During their development, water right in some irrigation systems has shifted. The biggest influence came from the change of cropping pattern in the system. Systems with uniform planting pattern, especially which are dominated by rice, keep on applying the riparian right. Examples of such systems are Glapan and Klambu Kiri. On the other hand, systems with diversified planting pattern shifted the water right to utilitarian right. In this system, farmers valued water based on its function as an input to agricultural production.

Irrigation Financing

The main principle of transferring authority in irrigation management is getting farmers as decision makers in irrigation management. The management surely involves a financial element. National-level rules on financing have been established. Some of the items in relation to regional conditions have been accommodated in regional rules on irrigation. The regional rule on irrigation in Yogyakarta Special Province and Central Java cites that the regional government is in charge of financing the main network and the structure, while WUF and WUAs are responsible for secondary and tertiary levels, respectively.

Donation for financing the main network derives from each regional income and expenditure plan. WUAs and WUF get some amount from ISF. The amount of ISF in sample areas is area-based and paid once a year. The amount of ISF of each hectare is approximately Rp 15,000 to Rp 50,000 and is decided at a WUA member meeting. The fee is not different for head, middle or tail area or for any crop. The fee in most sample areas is collected door to door by WUA managers or rural officials. This withdrawal in general is inefficient because:

- WUA managers do not get a salary so that ISF is not strictly collected.
- Society supposes that water has been provided by nature. Consequently, there is no need to spend money to get water.
- Farmers in the upstream area feel there is sufficient water, while those downstream feel water is in short supply. Both have reasons for not paying the ISF.

Management of Irrigation System

Prior to 1999, joint management was conducted in all technical irrigation systems in Indonesia. In this system, the government managed primary and secondary levels while WUAs managed their tertiary blocks. Water is allocated, based on the crop water requirement of all tertiary blocks in the whole system. WUAs in each tertiary block proposed their types of crop, varieties and planting area of each variety. The water master, who was a government official, then developed a water balance, determined a global planting pattern and decided water allocation for each tertiary block. The actual water distribution was determined periodically (half a month) for the next period based on the global planting pattern and actual river discharge at the period. At secondary level, water was conveyed from primary to tertiary offtakes. At the tertiary level, water diverted from tertiary offtakes was distributed throughout the whole block. Members of the WUA engineering staff were responsible for distributing it equally.

After the launching of Irrigation Management Policy Reform in 1999, the GOI gradually transferred the management of some irrigation systems to WUAa. The management was transferred to the WUA that was ready, either at the secondary or primary level. This resulted in the variation of management in the selected systems.

Among six schemes in the Kalibawang system, Papah and Pengasih schemes were transferred in 1999 while the other schemes were transferred in 2002. In Papah and Pengasih schemes WUAF managed the secondary level starting from the main diversion structure while government officials managed the main intake. In the Kalibawang scheme, two WUAFs shared the management of the Kalibawang Primary Canal. In Pekik Jamal, WUAF manages the system from the main intake to the primary and secondary canals.

The Krogowanan system was transferred in 1999. Currently, the WUAF of Krogowanan system manages the system up to the primary canal. However, a government official is still responsible for managing water diversion from the main intake in the Pabelan river.

In Klambu Kiri and Glapan systems, Irrigation Management Transfer has not been implemented. Therefore, the two systems still keep the joint management where WUA manages tertiary levels and the government manages the rest of it. Preparation for the transfer is still in the process of WUAF establishment, which is prepared to manage secondary and primary levels.

Selected Rain-fed Areas

The selected rain-fed site is in the Tuksono village in the Sentolo district of Kulonprogo Regency. The site is located in a hilly area between the Papah scheme of the Kalibawang system to the west and the Progo river to the east. Because of its location in the hilly area, it is not irrigated from the technical irrigation system. Generally, the soil condition is clayey and it contents are poor nutrients. Main crops cultivated in the rain-fed area are rice, maize, soybean and *kacang tolo* (cowpea). The proportions of the area of rice, maize, soybean and *kacang tolo* are 46.57 percent, 42.31percent, 10.42 percent, and 0.69 percent, respectively. Most of rice fields in the area are rain-fed. However, some pieces of land surrounding mushroom cultivation received some water. Based on its topography, the area is divided into three parts: high, medium and low.

High Area

Rainfall is the main water source of the area, and cropping patterns is rice-maize. In case there is no rainfall, some farmers depend on seepage from adjacent springs or shallow wells. If water is not available from any source, farmers let their lands fallow. Rice productivity ranges from 2 to 3 tons/ha. Employment opportunities in agriculture are very limited and most laborer farmers seek work in nearby irrigated areas.

Besides farming, most people of the area rely for their livelihoods on raising cattle. Home gardening is common, and people grow *gebang*, a kind of crop that produces *agel* fiber for handicrafts. Some people grow teak wood but they need a long time to harvest the wood. Since 1988 people in the area have been producing *agel* handicrafts in the area. As a worker a person receives Rp 5,000 to 8,000 for 2 to 3 days’ work. Off-farm activities contribute 25-30 percent of their household income.

Middle Area

Cropping pattern of the area is generally maize-rice-maize, especially in the locations close to springs or shallow wells. Some farmers use liquid waste from the mushroom cultivation industry to irrigate their lands. The liquid waste contains organic matter and nutrients required by crops. Some farmers are able to practice a cropping pattern of rice-rice-maize by utilizing the waste. In other subvillages cropping the pattern practiced is rice-maize. If soil moisture is available, they will also grow soybean. Most of the people in the area have tamarind and melinjo trees in their home gardens. However, they do not grow well because of inadequate water. Off-farm activities include working as laborers in the mushroom industry and in bag and nylon industries. These activities contribute around 60 percent of their household income. Most farmers work within the village.

Low Area

The agricultural activities in the area depend on rainfall. In dry season, most of the farmers irrigate their lands from shallow wells manually. A few farmers use diesel pumps to abstract water from shallow wells or irrigation canals to irrigate their lands. The effort to use dug wells became unpopular because landholding size is small. The cropping pattern practiced in the area is rice-maize-maize or rice-*kacang benguk* (*mucuna prurient)*. *Kacang benguk* is a type of bean that can improve soil fertility by producing nitrogen in plant roots. It also needs a simple maintenance and a few inputs but gives good returns. Perennial crops in home garden are tamarind and *sawo*. The perennial crops are harvested twice a year. Most of the people work as daily workers in irrigated areas close to their village. Off-farm opportunities include making *agel* handicraft. *Agel* handicraft contributes about 15 percent to household income.

3.3. DATA, APPROACH AND METHODS

As mentioned earlier, the government has recently undertaken an irrigation policy reform. Therefore, it focuses all activities of irrigation development in the country into the implementation framework of the policy reform. All programs and activities should be done in the context of the new policy. The main principles of the new policy are:

Policy 1. Redefinition of the role and responsibility of irrigation management institutions

Policy 2. Empowerment of WUAs

Policy 3. IMT

Policy 4. Reformulation for financing irrigation development and management

Policy 5. Sustainability of the irrigation system

In general, the new paradigm of irrigation management that is stated in GR No. 77/2001 has the objective of increasing farmers' prosperity through raising their income by promoting the crop diversification and agricultural modernization principle. Implicitly the GR also points toward poverty alleviation.

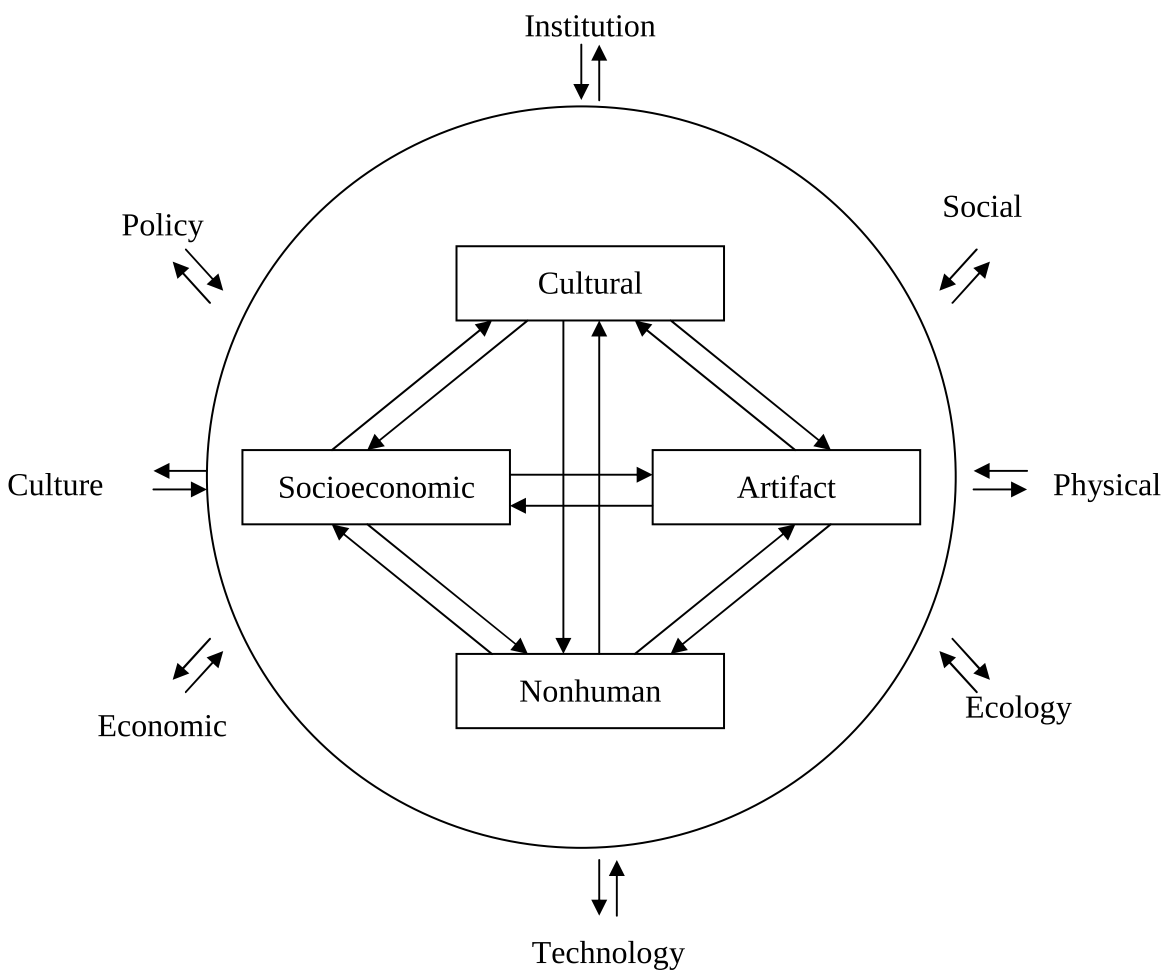
System Approach in Irrigation Management Study

According to Walter and Huppert (1989), irrigation system management can be considered as sociotechnical system. It means that irrigation management consists of two aspects, i.e., a technical subsystem and a social subsystem. Pusposutardjo (1996) developed Walter and Huppert's definition by applying the sociocultural concept in the irrigation management. This concept is developed based on the nature of irrigation development and management as a process of human-being development. In that case farmers are central to irrigation development and management. As a sociocultural system focusing on human-being development, there are four subsystems that form the entire irrigation management as a sociocultural system: a). cultural, b) socioeconomic, c) artifact (with technology belonging to the subsystem), and d) nonhuman subsystem. Seemingly, as a sociocultural system, irrigation management would vary spatially and among subcultural systems of farmers.

Irrigation management as a sociocultural system has eight strategic environments. These are policies, social, cultural, technical, physical, institutional and ecological environments. Changing of paradigm and policy reform in irrigation management and development, as recently happened in Indonesia, could be considered as change in policy environment, and thus would create some responses of all subsystems in the whole irrigation management as a sociocultural system.

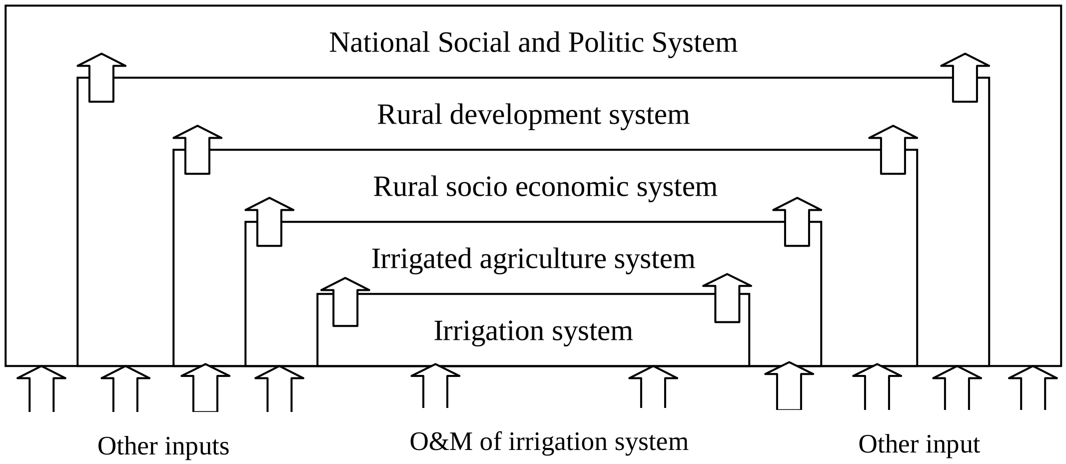
From a sociocultural point of view, the study would focus on developing understanding of responses that would be made by each subsystem and how the system works to make a new equilibrium process with changes in its environments. Figure 3.3.1 shows the context of irrigation as a sociocultural system under equilibrium stage with its strategic environment.

Figure 3.3.1. Irrigation as a sociocultural system under the equilibrium stage with its environment



Small and Svendsen (1992) introduced another system approach in irrigation management and called irrigation management as a nested system. This approach was based on a management process in a hierarchy of irrigation system management levels. The nested system consists of five subsystems, namely: a) irrigation network, b) irrigated agriculture, c) rural socioeconomic, d) rural development, and e) national politico-subsystem. Based on the nested system, analysis of irrigation management policy should cover analysis at several levels of management, including analysis at micro, mezzo and macro levels. Irrigation management as the nested system is shown in figure 3.3.2. Theoretically, based on the nested system, the irrigation management in the new concept of policy reform has shifted from the second nest (irrigation as an input to production of irrigated agriculture) to the third or fourth nests (irrigation as an input to rural socioeconomic and rural development process).

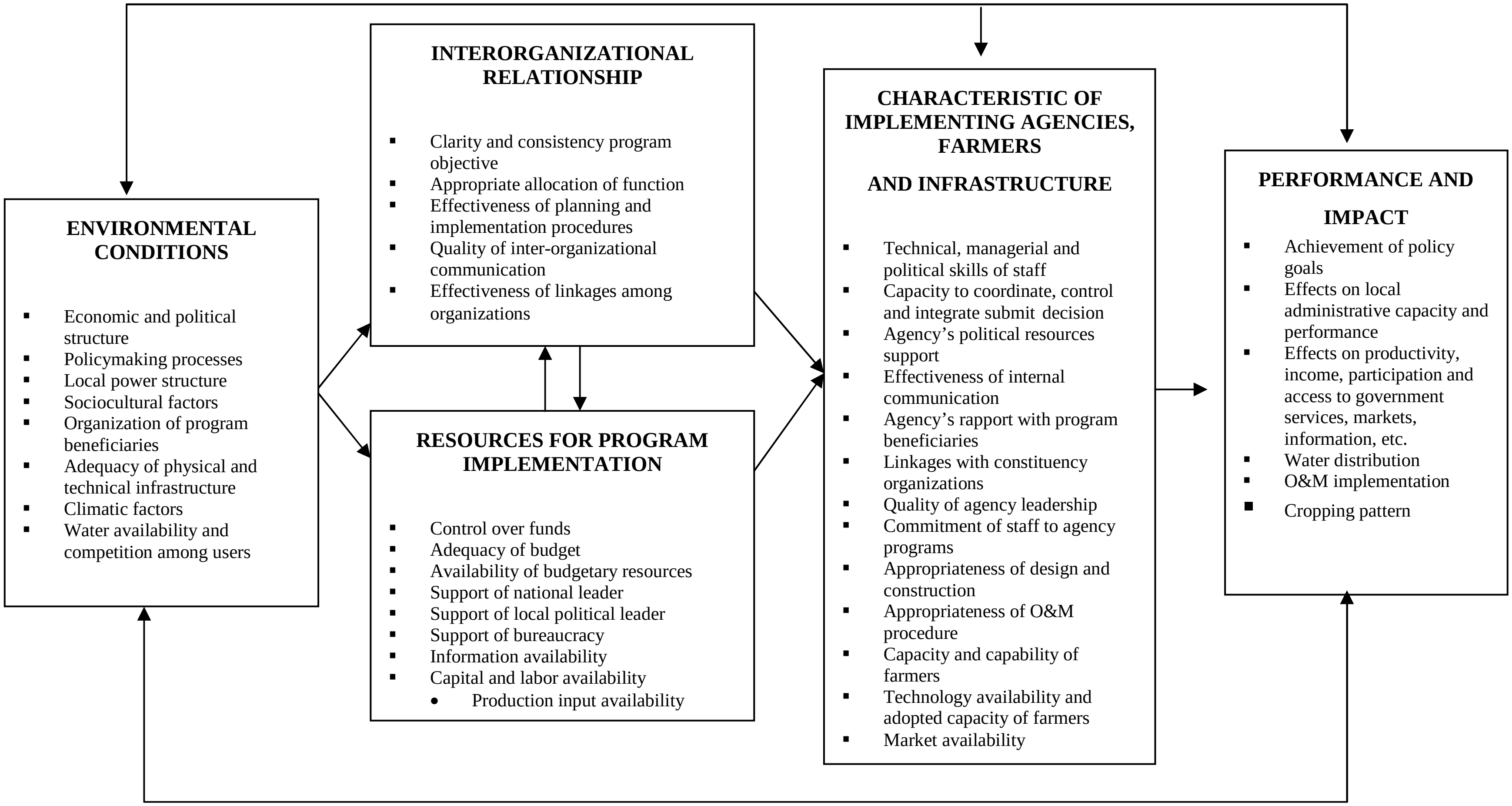
Figure 3.3.2. Irrigation as a nested system (modified from Small and Svendsen 1992).



Based on system approach, there are three aspects that are very basic to be analyzed in the study on irrigation development and management and its relationship with poverty. These are a) institutional aspect that includes study on rule-in-use, organizations and other social and cultural aspects, b) socioeconomic aspect, and c) irrigation performance as an effect and impact of irrigation management. To do so, in-depth studies were undertaken in specific areas, some of which have significant poverty.

Participatory Rural Appraisal (PRA), one of the participatory methods for gathering data and information was implemented. In addition, quantitative information was obtained through household level questionnaire surveys. At macro and meso levels, the study analyzed irrigation and agricultural development policies, strategies and implementation programs. At the micro level, the study focused on analysis of performance of irrigation and impact of the policies. Analysis also covered identification of factors affecting implementation programs as shown in figure 3.3.3.

Figure 3.3.3. Factors affecting implementation of pro-poor irrigation development and management policies (modified from Cheema and Rondinelli 1983).



Sampling Procedures

System Selection

Four systems had been selected for in-depth study representing large- and medium-scale irrigation systems in Indonesia. They are Kalibawang, Krogowanan, Klambu Kiri and Glapan. These systems vary in terms of size of the system, water availability, IMT experience, incidence of poverty and number of regencies in irrigated area. The general characteristics of selected irrigation system are presented in table 3.3.1.

Table 3.3.1. Characteristics of selected irrigation systems.

	System			
	Kalibawang	Krogowanan	Klambu Kiri	Glapan
Size of irrigation system	6,454 ha (Medium)	813 ha (Small)	21,475 ha (Large)	18,284 ha (Large)
Water availability	Shortage	Surplus	Adequate	Shortage
IMT experience	Yes	Yes	No	No
Incidence of poverty	High	Low	High	High
Number of regencies in irrigated area	1	1	1	2

The selected systems are clustered based on the area and position related to the main river. The Kalibawang system's three schemes, Kalibawang, Pngasih and Pekik Jamal, were chosen for gathering information through household surveys as well as for analyzing the physical performance based on historical secondary data. Since Kalibawang schemes have only one primary canal with tertiary offtakes along it, the canal was divided into three sections to represent head, middle and tail. Pengasih and Pekik Jamal have two secondary canals each. All of them were selected as samples in this study.

The Krogowanan system (primary canal) was divided into three parts: head, middle and tail to collect primary data and information. From Klambu Kiri, three secondary canals, namely Mlekang, Wulan 1 and Wulan 4 were selected to represent head, middle and tail, respectively. In the Glapan system, seven secondary canals were chosen as samples. Jeketro, Rogol and Kauman are secondary canals in Glapan Timur, which are located at the head, middle and tail parts, respectively. In Glapan Barat, the selected canals are Kuniran and Kunjeng at the head of the scheme, Baturan at the middle and Bantengan at the tail.

Data Collection

Primary household-level data were collected through questionnaire surveys. The questionnaire consisted of several parts to gather information on irrigation, agriculture, income and expenditure, marketing, housing and irrigation institutions. All primary data were collected with the help of 15 enumerators who were given intensive training prior to administration of surveys. The questionnaire was pretested.

Participatory Rural Appraisal

Participatory Rural Appraisal (PRA) was conducted to obtain information from farmers and irrigation officials (bureaucracy). The checklists of questions for both PRAs were developed through many discussions and meetings among study team members. PRAs were conducted with the help of four facilitators. Altogether 30 PRA sessions were conducted in four irrigation systems. PRA exercise for farmers was completed in one month. PRA for officials was conducted in two locations, namely, Wates (capital city of Kulonprogo Regency) and Demak (capital city of Demak Regency).

Secondary Data

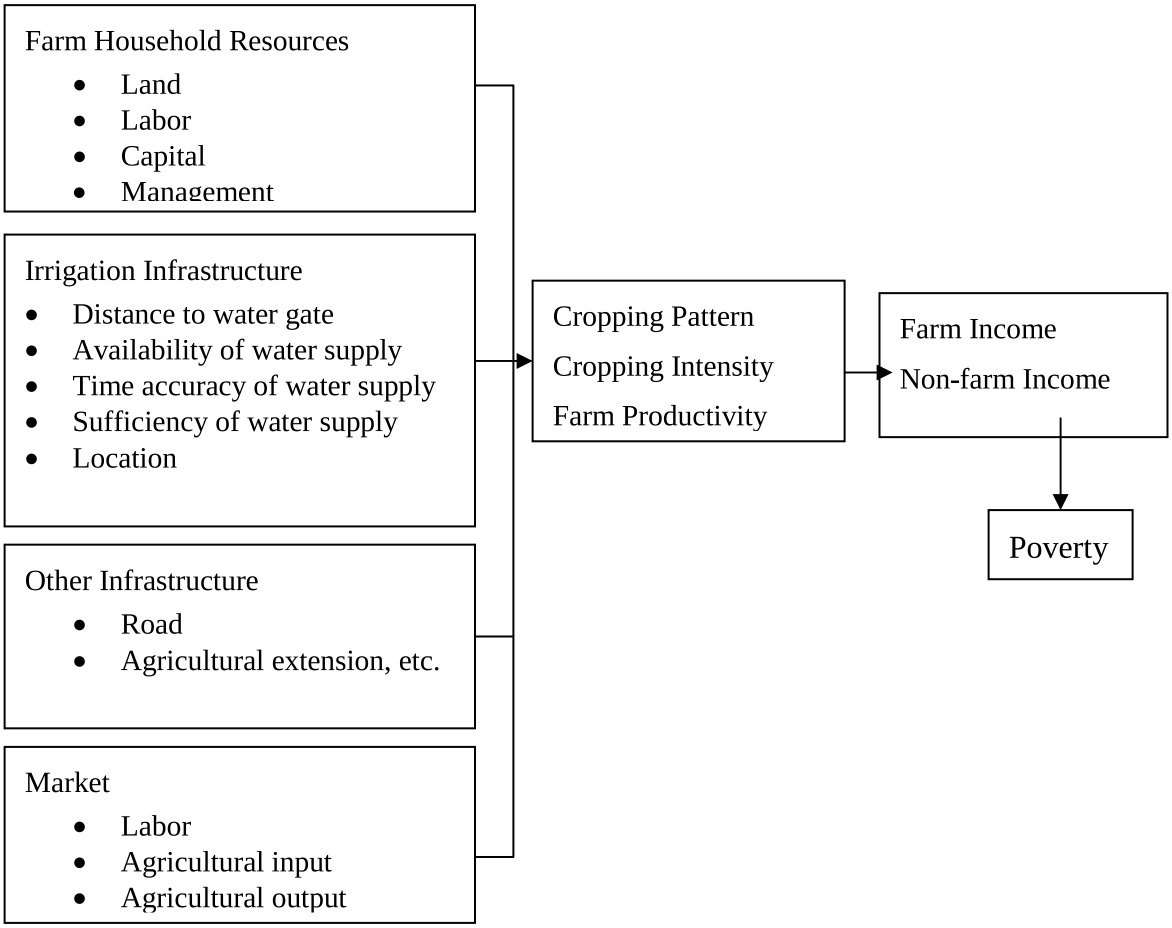
Data and information were also gathered from secondary sources. These included:

1. Previous studies of selected irrigation systems.
2. Historical data on climate and discharge.
3. Data on climate were collected for 5-10 years from three meteorological stations, namely Yogyakarta, Borobudur and Semarang. Data on river and main intake discharges were collected from regency offices of water-resources development.
4. Past research studies about socioeconomic condition of the farmers
5. Statistical data collected from Central Bureuau of Statistics for Demak Regency, Grobogan Regency, Magelang Regency and Kulonprogo Regency.
6. Legislation, such as Provincial Regulation, Regency Regulation, ministerial decision.

Poverty Analysis: Framework

Irrigation is one of agricultural inputs and therefore its relation to poverty is generally indirect (figure 3.3.4). Availability of irrigation facilities makes crops more responsive to agricultural inputs. Performance of agricultural facilities at farm level is measured in terms of distance to water gate, availability of water supply in each season, time accuracy of water supply in each season, sufficiency of water supply in each season and farm location in the system. Irrigation facilities accompanied by other factors, i.e., farm household resources (land, labor, capital, management), other infrastructure (road, agricultural extension) and market (labor, agricultural inputs, agricultural outputs) determine cropping pattern, cropping intensity, farm productivity and farm production. All of these actors then determine farm income. Total household income is summation of farm income and nonfarm income. Finally, farm household income determines per capita income and then farm household poverty.

Figure 3.3.4. Irrigation performance and poverty.



Under this logical framework, poverty is analyzed using headcount and poverty gap indices. Determinants of poverty are analyzed using the logit and probit model.

Headcount

Headcount is the share of the population that is poor, that is, the proportion of the population for which consumption or income is less than poverty line.

$$H = \frac{q}{n}$$

where

n = number of population

q = number of poor

Poverty Gap

Poverty gap represents the depth of poverty, which is the mean distance separating the population from the poverty line, with the not poor being given a distance of zero. There are two measures: (a) Poverty Gap (PG) and (b) Squared Poverty Gap (P2).

$$PG = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - yi}{z}\right]$$

$$PG = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - yi}{z}\right]^2$$

where,

PG	= poverty gap
n	= number of population
yi	= income of individual i
z	= poverty line

Gini Ratio

Gini ratio measures inequality in income distribution.

$$GR = 1 - \sum_{i=1}^{n} f_{pi} * \left(F_{ci} + F_{ci-1}\right)$$

where,

GR	= gini ratio
f_{pi}	= frequency of population in i^{th} income class
F_{ci}	= cumulative frequency of income in i^{th} income class
F_{ci-1}	= cumulative frequency of income in i-1th income class

Logit and Probit Model

$Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8 + \beta_9X_9 + \delta_1D_1 + \delta_2D_2 + e$

where,

Y = poor = 1, not poor =0

X_1 = size of irrigated area (ha)

X_2 = farm labor use (man-days)

X_3= non-farm labor use (man-days)

X_4= distance to water gate (m)

X_5 = availability of water supply (enough=1, not enough=0)

X_6 = time accuracy of water supply (accurate=1, not accurate=0)

X_7 = sufficiency of water supply (enough=1, not enough=0)

X_8 = farm income (000Rp/ha)

X_9 =farm production (000Rp/ha)

X_{10} = dummy for middle (middle=1, otherwise = 0)

X_{11} = dummy for tail (tail=1, otherwise=0)

α, β_1, β_2, …. , β_9, δ_1,δ_2 = parameter

e = random error

Methods for Assessing Irrigation System Performance

Irrigation performance assessment comprises of two subcomponents, namely characterization of irrigation system and assessment of performance using a specified set of indicators. Characterization of irrigation systems helped understand the context and the present situation of the system, including its resource base. Systems are characterized in terms of physical characteristics, agricultural characteristics, social and economic characteristics, as well as institutional characteristics. Performance is assessed in terms of two broad criteria: productivity, equity and water supply, and sustainability (table 3.3.2).

Table 3.3.2. Indicators to performance assessment of the irrigation system.

Broad criteria	Subcriteria	Indicators
Productivity, equity and water supply	Productivity	1. Irrigation intensity (II) 2. Cropping intensity (CI) 3. Output per unit area (OCOA) 4. Output per unit of diverted water (ODW) 5. Output per unit consumed water (OCW)
	Water supply	6. Relative water supply (RWS) 7. Relative irrigation supply (RIS) 8. Water delivery capacity (WDC) 9. Water delivery performance (WDP) 10. Overall system efficiency (OPE) 11. Head-tail equity in water supply (HTERW)
Sustainability	Environment	12. Percent of command area affected by water logging 13. Percent of command area affected by salinity 14. Groundwater depth 15. Percent of command area affected by chemical pollution
	Infrastructure	16. Number of infrastructure per 1000 ha 17. Number of control structure per 1000 ha 18. Percent of infrastructure in good condition 19. Percent of infrastructure in good functionality

Definitions of Performance Indicators:

1. Irrigation intensity is defined as the ratio of the net irrigated area to the design command area.

$$II = \frac{\text{net irrigated area in a year}}{\text{design command area}}$$

2. Cropping intensity is defined as the ratio of gross cultivated area to the design command area.

$$CI = \frac{\text{gross cultivated area in a year}}{\text{design command area}}$$

3. Output per unit area is defined as the ratio of the total sample production to the respective sample area.

$$OCOA = \frac{\text{production}}{\text{area}}$$

4. Output per unit of diverted water is defined as the ratio of actual total production to the total diverted irrigation water. It is computed as output per unit area divided by volume of diverted water per unit command area in a period of planting season.

$$ODW = \frac{\text{OCOA}}{\text{volume of diverted water / command area}}$$

5. Output per unit consumed water is defined as the ratio of the actual total production to the volume of water consumed by evapotranspiration (ET). It is computed as output per unit area divided by volume of ET per unit area in a period of planting season.

$$OCW = \frac{\text{OCOA}}{\text{volume of ET / command area}}$$

6. Relative water supply (RWS) is defined as the ratio of the total water supply to the crop water requirement. Total water supply consists of irrigation supply and rainfall. Crop water requirement is equal to ET crop. In the case of rice, crop water requirement includes ET, deep percolation and seepage.

For non-rice: $$RWS = \frac{\text{Irrigation} + \text{Re}}{\text{ETcrop}}$$

For rice: $$RWS = \frac{\text{Irrigation} + \text{Re}}{\text{ETcrop} + \text{Percolation} + \text{Seepage}}$$

7. Relative irrigation supply (RIS) is defined as the ratio of total irrigation supply to irrigation requirement. Total irrigation supply is equal to supply from irrigation system and does not include rainfall. Irrigation requirement is ET crop less effective rainfall.

For non-rice: $$RIS = \frac{\text{Irrigation}}{\text{ETcrop - Re}}$$

For rice: $$RIS = \frac{\text{Irrigation}}{\text{ETcrop - Re} + \text{Percolation} + \text{Seepage}}$$

8. Water delivery capacity (WDC) is defined as the ratio of canal capacity to deliver water at system head to peak consumptive demand. Peak consumptive demand is the peak crop irrigation requirement for a semi-monthly period expressed as flow rate at the head of the irrigation system.

$$WDC = \frac{\text{canal capacity}}{\text{peak consumptive demand}}$$

9. Water delivery performance (WDP) is defined as the ratio of actual to target volume of water delivered.

$$WDC = \frac{\text{canal capacity}}{\text{peak consumptive demand}}$$

10. Overall system efficiency (OPE) is defined as the ratio of crop water requirement to the total inflow into irrigation system.

$$OPE = \frac{\text{ETcrop}}{\text{irrigation supply}}$$

11. Head-tail equity in water supply (HTERW) is defined as the ratio of the average WDP of the upper 25 percent of the system to the average WDP of the tail 25 percent of the system.

Crop evapotranspiration (ET) is equal to reference evapotranspiration (ETo) multiplied by crop coefficient (Kc).

ETcrop = ETo x Kc

ETo is reference evapotranspiration computed from climatic data by using the Penman-Monteith approach as follows.

$$ETo = \frac{0.408\Delta(Rn - G) + \gamma \frac{900}{T + 273} U_2 (e_a - e_d)}{\Delta + \gamma(1 + 0.34U_2)}$$

where,

ETo = reference evapotranspiration (mm/day)

Rn = net radiation at crop surface ($MJ/m^2.day$)

G = soil heat flux ($MJ/m^2.day$)

T = average temperature (^oC)

U_2 = wind speed measured at 2 m height (m/s)

(ea-ed) = vapor pressure deficit (kPa)

Δ = slope vapor pressure curve ($kPa/^oC$)

γ = psychrometric constant ($kPa/^oC$)

Effective rainfall is computed by using USDA method as follows.

$$P_{eff} = \frac{\left(\mathrm{P}_{\mathrm{month}}\left(125 - 0.2 \times P_{month}\right)\right)}{125} \quad P_{month} \leq 250\ mm$$

$$P_{eff} = 125 + 0.1 \times P_{month} \quad P_{month} > 250\ mm$$

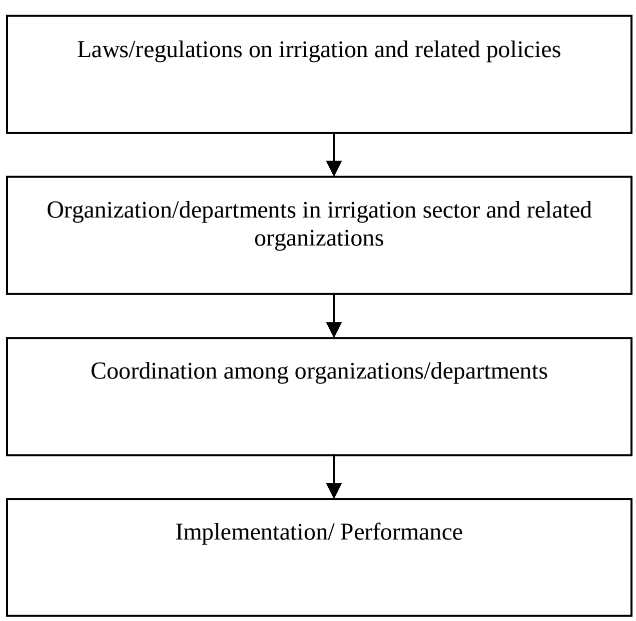
where,

P_{month} = monthly rainfall

P_{eff} = effective monthly rainfall

Institutional Analysis

In this study, the term institution is defined as the set of rules actually used (the working rules or rules-in-use) by a group of people to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others (Ostrom 1992). Based on this definition, the study focused on two important aspects of institutions, i.e., organizational and legal aspects, respectively. Considering the concepts of Saleth and Dinar (1999) and Hussain and Biltonen (2001) such as shown in the Term of References of the study as well as Cheema and Rondinelli (1983) as shown in figure 2, an analytical framework of this report is given as follows:



Laws/regulations on irrigation and related policies in this model are based on the GR number 77/2001 and its organic or related regulations. *Organizations/departments in irrigation sector* in this model cover those at macro, meso, as well as at system level. *Coordination among the organizations/departments* in this model also covers those three levels, both vertically and horizontally. *Implementation/performance* in the model deals with the performance of institutions at these three levels as stated in the GR 77/2001. Study on organizational aspects covered three levels of irrigation management organizations, i.e., a) irrigation system level, b) meso level that consists of both district and provincial levels, and c) macro or national level, respectively. At all these levels, the study analyzed various factors that influence performance or organization.

3.4. POVERTY IN IRRIGATED AGRICULTURE: SPATIAL DIMENSIONS

Profile of Sample Households

The total sample sizes in the selected systems, Klambu Kiri, Glapan, Krogowanan and Kalibawang, are 300, 250, 100 and 250, respectively. The proportion of sample sizes in head, middle and tail reaches of the selected systems are shown in table 3.4.1. The average ages of farmers are 40-55 years, which is the typical age for farmers in Java or in the outer islands. Farmers in all systems are in the productive age. The family size is between 4 and 5 members, which is also typical for Java and Indonesia as a whole.

Table 3.4.1. Number of respondent, age of farmer and number of family member.

System	Location land	Number of respondents (farmer)	Age of farmer (years)	No. of family members (persons)
Klambu Kiri	Head (H)	98 (32.67%)	46.77	4.73
	Middle (M)	99 (33.00%)	46.70	4.83
	Tail (T)	103 (34.33%)	47.37	5.34
	Total sample	300		
Glapan	Head (H)	84 (33.60%)	46.26	5.30
	Middle (M)	98 (39.20%)	48.37	4.77
	Tail (T)	68 (27.20%)	48.38	4.75
	Total sample	250		
Krogowanan	Head (H)	51 (50.49%)	43.80	4.63
	Middle (M)	33 (32.67%)	52.88	4.61
	Tail (T)	17 (16.84%)	56.82	3.71
	Total sample	100		
Kalibawang	Head (H)	115 (46.00%)	48.82	4.33
	Middle (M)	51 (20.40%)	52.04	4.47
	Tail (T)	84 (33.60%)	48.13	4.61
	Total sample	250		

Source: Primary Data 2002

Size of Landholding

Table 3.4.2 shows that the average size of landholding per household in Klambu Kiri (0.56 –1.14 ha) and Glapan (0.62–1.09 ha) is higher than that in Krogowanan (0.28–0.40 ha) and Kalibawang (0.21–0.27 ha). In Klambu Kiri and Glapan, the average size of landownership at the middle reach is higher than that at the head and tail reaches. In Krogowanan and Kalibawang, the average size of landownership at the tail reach is higher than that at the head and the middle reaches. Overall, average land size is relatively higher in Klambu Kiri and Glapan compared to a typical land size in Java as a whole while in Krogowanan and Kalibawang the land size is representative of the island as a whole.

Renting of agricultural land is generally small. Similar to the size of the owned land, the size of operated land in each system in Klambu Kiri and Glapan is higher than that in Krogowanan and Kalibawang. Due to shortage of irrigation water during DS II in some parts of the systems, the average size of operated land per farmer is smaller than that in the rainy season (RS) and DS I. This is quite common in the middle and tail reaches of Klambu Kiri and in the head of the Glapan system.

Table 3.4.2. Size of owned and operated land (ha).

	Location of land	Owned land	Rented in			Rented out	Operated		
			DS II	RS	DS I		DS II	RS	DS I
Klambu Kiri	Head	0.56	0.14	0.17	0.17	0.07	0.63	0.67	0.67
	Middle	1.14	0.21	0.27	0.25	0.40	0.81	1.01	0.99
	Tail	0.60	0.20	0.33	0.33	0.07	0.52	0.87	0.87
Glapan	Head	0.62	0.17	0.30	0.30	0.10	0.44	0.85	0.85
	Middle	1.09	0.06	0.07	0.07	0.45	0.62	0.72	0.72
	Tail	0.94	0.16	0.16	0.16	0.27	0.77	0.83	0.83
Krogowanan	Head	0.28	0.04	0.05	0.05	0.04	0.24	0.28	0.28
	Middle	0.37	0.04	0.10	0.10	-	0.35	0.45	0.45
	Tail	0.40	0.34	-	-	0.07	0.38	0.42	0.42
Kalibawang	Head	0.21	0.05	0.06	0.06	0.03	0.20	0.23	0.23
	Middle	0.24	0.14	0.15	0.15	0.03	0.32	0.33	0.32
	Tail	0.27	0.03	0.02	0.03	0.05	0.22	0.24	0.25

Source: Primary data, 2002.

Cropping Patterns

In all systems, rice is the dominant crop in the rainy season and DS I (table 3.4.3). Other crops planted during these seasons are onion and chili (Klambu Kiri), eggplant and watermelon (Glapan), tomato and cabbage (Krogowanan), chili and onion (Kalibawang). In DS II, farmers grow several crops, i.e., *palawija* (maize, peanut, soybean, mungbean, and so on) and vegetables (chili, onion, tomato, cabbage and so on). In Klambu Kiri and Glapan, mungbean is the dominant crop during DS II while in Krogowanan and Kalibawang, *palawija* and vegetables dominate the copping patterns.

Cropping patterns in Kalibawang and Krogowanan systems are more complex than those in Klambu Kiri and Glapan systems. In Kalibawang and Krogowanan, *palawija* and vegetables are planted not only during DS II but also in the rainy season and DS I. In Klambu Kiri and Glapan, *palawija* and vegetables are merely planted during DS II. In Kalibawang and Krogowanan, there is strong cooperation among farmers in using irrigation water. In these systems, farming has been shifting from rice to non-rice crops.

Table 3.4.3. Cropping pattern and area planted (ha).

System	Crops	DS II			RS			DS I		
		H	M	T	H	M	T	H	M	T
Klambu Kiri	Mungbean	0.64	0.84	0.63						
	Soybean		0.03	0.04						
	Watermelon		0.07							
	Rice				0.64	1.00	0.72	0.64	0.91	0.72
	Onion		0.09	0.11		0.10	0.11		0.17	0.11
	Chili		0.08	0.05		0.01			0.03	
	Total	0.64	1.11	0.83	0.64	1.11	0.83	0.64	1.11	0.83
Cropping Intensity (%)								300	300	300
Glapan	Mungbean	0.26	0.51	0.54						
	Rice		0.19	0.01	0.80	0.79	0.87	0.79	0.79	0.87
	Corn	0.05								
	Total	0.31	0.70	0.55	0.80	0.79	0.87	0.79	0.79	0.87
Cropping Intensity (%)								237	289	263
Krogowanan	Maize		0.02							
	Longbean	0.014	0.04	0.04				0.007		0.01
	Mustard Green		1.35					0.02		
	Cauliflower	0.02	0.05		0.01	0.02				
	Onion	0.12	0.05							
	Rice	0.05	0.13	2.04	0.22	1.39	2.1	0.22	0.31	2.08
	Tomato	0.08	0.07	0.01	0.01			0.002	0.03	
	Cabbage	0.07	0.01			0.01		0.001	0.01	
	Cucumber	0.01	0.01							
	Chili			0.03	0.03			0.02	0.07	0.06
	Tobacco							0.01		
	Total	0.354	1.77	2.14	0.27	1.46	2.1	0.28	0.42	2.15
Cropping Intensity (%)								257	206	297
Kalibawang	Rice	0.01		0.001	0.23	0.33	0.23	0.21	0.30	0.23
	Soybean	0.1	0.22	0.07	0.001			0.007		0.02
	Chili	0.05	0.04	0.04	0.03		0.004	0.06	0.01	0.05
	Peanut	0.05	0.04		0.002			0.0009		
	Onion	0.04	0.05	0.04	0.01		0.001	0.005	0.002	0.03
	Maize	0.06	0.01	0.04	0.0003		0.002	0.006		0.0007
	Longbean	0.002								
	Mungbean	0.05	0.006	0.003	0.003					
	Cucumber	0.003		0.01				0.003		0.003
	Kc. Tolo	0.03	0.007	0.01						
	Mustard green	0.02		0.01						
	Bawang Daun	0.03		0.01	0.002		0.003	0.007		0.02
	Water melon			0.003						0.001
	Leafy Vegetable				0.002			0.002		0.02
	Egg plant							0.003		
	Total	0.445	0.373	0.257	0.2803	0.33	0.24	0.3039	0.312	0.3747
Cropping Intensity (%)								231	272	233

Source: Primary Data 2002.

Cost of Crop Production

Farm labor use per ha is related to cropping patterns and season. Kalibawang has complex cropping patterns, and the labor use per ha in this area much higher compared to other three systems. Labor use per ha is more during rainy season and dry season I compared to that during dry season II. This is because of availability of more water and more intensive farming operations during these seasons. In Klambu Kiri, labor use per ha is the lowest, but the cost of labor use is the highest due to higher wages in the area (table 3.4.4). Farmers in Klambu Kiri employ more hired labor than family labor and also pay them higher than that in other areas. Comparing the use and cost of labor per hectare across systems, it is found that there is no significant difference in labor use and cost across head, middle and tail reaches of the systems.

Table 3.4.4. Labor use and labor cost.

System		DS II			RS			DS I		
		H	M	T	H	M	T	H	M	T
Klambu Kiri	Per farm									
	a. Amount (MD)	55.05	25.37	5.51	43.62	66.56	53.98	21.16	37.08	27.37
	b. Cost (Rp ’000)	343	325	60	753	1313	1105	728	1243	1051
	per hectare									
	a. Amount (MD)	55.04	25.60	5.72	68.16	59.96	65.04	33.06	33.40	32.97
	b. Cost (Rp ’000)	537	293	73	1177	1183	1331	1138	1120	1266
Glapan	per farm									
	a. Amount (MD)	7.38	31.27	34.68	43.62	44.27	54.22	44.48	46.25	53.01
	b. Cost (Rp ’000)	7	12	3	863	911	1018	787	860	916
	per hectare									
	a. Amount (MD)	23.81	44.67	63.05	54.53	56.04	62.32	56.30	58.54	60.93
	b. Cost (Rp ’000)	24	17	5	1079	1153	1171	997	1089	1054
Krogowanan	per farm									
	a. Amount (MD)	29.29	20.5	28.63	33.52	37.96	109.53	33.34	46.44	103.24
	b. Cost (Rp ’000)	149	68	138	215	301	137	103	215	133
	Per hectare									
	a. Amount (MD)	82.74	11.58	13.37	124.14	26	52.15	119.07	110.57	48.01
	b. Cost (000 Rp)	421	38	65	796	206	65	767	919	133
Kalibawang	Per farm									
	a. Amount (MD)	16.11	13.06	12.71	32.84	39.31	30.77	31.98	41.33	45.35
	b. Cost (000 Rp)	37	33	40	233	247	191	188	242	271
	Per hectare									
	a. Amount (MD)	36.2	35.01	49.45	117.28	119.12	128.20	106.6	132.46	121.05
	b. Cost (000 Rp)	84	89	158	833	749	795	619	777	722

Source: Primary Data 2002.

Cost of production per ha (seeds, fertilizers, pesticides, and other inputs) is highest in Klambu Kiri, followed by Glapan, Kalibawang, and Krogowanan system (table 3.4.5). Differences in cost of production are due to types of inputs and tenurial status of farmers (i.e. owner or tenant farmer). Cost of fertilizers and pesticides constitute major components of total cost of production. Other cost components are cost of seed, land rent, share crop, land tax, irrigation fee, and food for hired labor.

Table 3.4.5. Costs of seeds, fertilizers, pesticides and others.

System		DS II			RS			DS I		
		H	M	T	H	M	T	H	M	T
Klambu Kiri	Per farm (000Rp)									
	a. Seeds	87	355	63	97	582	110	97	646	200
	b. Fertilizers	15	146	32	352	613	574	400	652	518
	c. Pesticides	174	213	63	81	262	148	93	276	168
	d. Others	30	63	83	616	728	767	855	440	545
	Total	306	777	241	1146	2185	1599	1445	2014	1431
	Per ha (000Rp)	478	700	290	1790	1968	1926	2257	1814	1724
Glapan	Per farm (000Rp)									
	a. Seeds	15	55	105	97	107	139	98	106	138
	b. Fertilizers	3	16	7	406	368	411	428	366	413
	c. Pesticides	35	175	354	53	61	84	63	72	100
	d. Others	13	29	48	984	367	647	426	123	210
	Total	66	275	514	1540	903	1281	1015	667	861
	Per ha (000Rp)	82	348	591	1925	1143	1472	1268	844	989
Krogowanan	Per farm (000Rp)									
	a. Seeds	75	37	30	60	77	37	52	53	85
	b. Fertilizers	352	181	164	251	627	234	219	531	255
	c. Pesticides	36	21	10	56	109	20	33	40	18
	d. Others	189	43	77	206	564	199	165	452	182
	Total	652	282	281	573	1377	490	469	1076	540
	Per ha (000Rp)	1841	159	131	1618	778	228	1324	608	251
Kalibawang	Per farm (000Rp)									
	a. Seeds	49	96	48	70	69	57	62	101	55
	b. Fertilizers	57	66	43	222	272	248	169	218	199
	c. Pesticides	12	7	9	26	8	13	13	9	12
	d. Others	28	30	12	132	317	74	70	210	47
	Total	146	199	112	450	666	392	314	538	313
	Per ha (000Rp)	328	533	302	1011	1800	1059	706	1454	846

Source: Primary Data 2002.

Production of Food Crops and Other

Food crops, i.e., rice, *palawija* and vegetables, are planted in irrigated areas while perennial crops are planted in upland areas and home gardens. Perennial crops include coconut, cocoa, breadfruit, papaya and banana. Depending on the size of landholdings, production of perennial crops varies from system to system and location to location. Coconut is the dominant perennial crop in all systems. In general, Krogowanan and Kalibawang have more crop varieties compared to Klambu Kiri and Glapan (table 3.4.6). In Klambu Kiri, rice productivity is higher in the head reach compared to that at the middle and tail reaches. In Glapan, Krogowanan and Kalibawang the highest productivity of rice was found in the middle areas of the systems (table 3.4.7). For other food crops, there is a general trend that the middle area of the system has higher productivity than that at the head and tail areas. Table 3.4.8 shows productivity of food crops, while table 3.4.9 shows production of perennial crops per year. Table 3.4.10 shows that only a few farmers raise cows and buffaloes, as livestock rearing is a capital-intensive activity. Some farmers raise goats and almost all farmers raise chicken. Only a few farmers have fishponds, except in Krogowanan (table 3.4.11).

Table 3.4.6. Productivity of food crops in DS II (tons/ha).

Crops	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
1.Rice					4.500	3.000	2.891	3.293	2.918	5.478		6.420
2.Soybean		0.854	0.230							1.005	1.264	0.484
3.Chili		0.039	0.533				1.919	0.765		1.073	1.295	0.335
4.Mungbean	0.586	0.497	0.072	0.312	0.660	0.741				0.117	0.038	0.097
5.Longbean							0.279	15.000	2.429	0.014		
6.Peanut												0.275
7.Maize				0.200					2.000	0.826	0.009	0.323
8.Onion		2.190	0.267							2.181	0.871	0.222
9.*Kc Tolo*										0.137	0.067	0.289
10.Mustard green								2.667		1.385		4.913
11.Tomato							1.614	1.593				
12.Cl flower							5.962	3.360				
13.Cabbage							0.918	0.633				0.708
14.Cucumber							16.912					27.032
15.Watermelon		0.033										0.125
16.*Bw daun*							0.019					1.483

Source: Primary Data 2002.

Table 3.4.7. Productivity of food crops in the rainy season (tons/ha).

Crops	**Klambu Kiri**			**Glapan**			**Krogowanan**			**Kalibawang**		
	H	**M**	**T**	**H**	**M**	**T**	**H**	**M**	**T**	**H**	**M**	**T**
1.Rice	5.969	3.957	3.509	4.009	4.593	4.365	3.078	3.728	3.288	4.276	5.967	4.051
2.Chili		0.600					2.298	9.425		2.474		2.492
3.Peanut										1.500		
4.Onion		0.827	0.424							1.664		8.395
5.Maize								6.250	5.000	5.000		1.917
6.Mustard greens							0.400			0.050		0.021
7.*Bw daun*							0.600			1.855		3.250
8.Cauli flower							1.000	7.467				
9.Tomato							5.333	12.500				
10.Cabbage							10.000	6.400				
11.Soybean										2.510		
12.Leafy vegetable										1.217		

Source: Primary Data 2002.

Table 3.4.8. Productivity of food crops in DS (tons/ha).

Crops	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
1.Rice	4.107	3.366	2.890	1.582	1.986	2.420	2.826	3.336	2.420	3.410	4.630	3.263
2.Soybean										3.508		
3.Chili		4.069					3.088	14.325	6.000	1.381	0.401	0.476
4.Peanut										1.146		
5.Onion		0.921	0.276							1.098	2.592	1.652
5.Maize								6.250		1.946		1.000
6.Longbean							3.026		5.000			
7.Cucumber										0.656		
8.Mustard greens							0.133	0.100		0.037		
9.Watermelon												8.697
10.Tomato							1.923	5.725				
11.Cabbage							8.000	6.250				
12.Egg plant										54.688		
13.Sugarcane			139.535									
14.Tobacco								2.500				
15.Salacca								0.341				
16.Sweet potato												9.750

Source: Primary Data 2002.

Table 3.4.9. Production of perennial crops per year (kg/farm).

Crops	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	**T**
1. Coconut	33.26			170.00	58.94	9039.40	159.98	252.73	228.24	715.00	312.75	828.45
2. Mango	0.02			0.12	0.13	0.15	0.04			0.48	1.18	1.19
3. Orange							0.04			3.30		
4. Rose apple							0.08					0.95
5. Rambutan							3.98	15.45	23.71	18.77	6.80	
6. Bananas	0.44	0.25		2.47	9.93	6.11	1.67	0.45	15.00	5.17	8.26	8.99
7. Papaya					12.24						0.78	1.49
8. Bamboo							0.41	3.64	1.47	1.13	0.49	6.51
9. Salacca							0.02	1.09	4.71	0.03		
10. Cocoa							0.02			1.62	0.35	0.89
11. Breadfruit							0.02	2.73			0.98	
12. Clove							0.22			0.11	0.10	
13. Sapodilla							0.02					0.30
14.Gnetum-Gnemon				0.08			0.02					1.19
15.Starfruit							0.02					

Source: Primary Data 2002.

Table 3 4.10. Average number of livestock (unit/farm).

	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
1. Cow		0.02		0.01			0.37			1.39	0.49	1.00
2. Buffalo							0.20			1.15	0.04	0.06
3. Goat	0.19	0.07	0.22	0.14	0.64	0.34	0.78	0.42		0.65	0.49	0.49
4. Chicken	3.52	3.15	1.43	3.04	6.04	1.29	6.14	7.61	6.00	11.64	9.80	11.79
5. Duck	1.02		0.05	0.37		2.94	941.10	1.33		0.13	0.27	14.38
6. Manila Duck	0.10							0.21	0.71	0.13	0.57	
7. Bangkok Chicken	0.04									0.05		
8. Quail	0.04	20.20										9.52
9. Mentok	0.02									0.09	0.10	
10. Broiler		30.30										11.90
11. Pigeon							0.14				0.25	9.52
12. Arabic Chicken							0.05	1.21				
13. Rabbit								0.45				

Source: Primary Data 2002.

Table 3.4.11. Average size of fishpond (M2).

System	Head		Middle		Tail	
Klambu Kiri	3.63	Catfish	5.86	Catfish	0.87	Catfish
Glapan		-	3.47	Catfish		-
Krogowanan	6.06	Catfish	415.80	Gurami	52.94	*Mujair*
		Mujair		*Mujair*		*Nila*
		Nila		*Nila*		*Waderbang*
				Bawal		
Kalibawang	2.74	Catfish	0.37	Catfish	6.39	Catfish
		Gurami				Gurami
		Mujair				
		Nila				

Source: Primary Data 2002.

Household Income and Expenditure

Farm Household Income

Farm household income is derived from several sources, i.e., food crop, perennial crop, livestock, fishpond, and off-farm jobs. Food-crop income has a direct relationship to irrigation while other sources of farm household income have no direct relationship with irrigation. This section presents food crop income, total farm income and off-farm income.

Table 3.4.12 shows that the relationship between irrigation and farm income differs across four systems. In Klambu Kiri, the highest farm income is estimated for the head reach while in Glapan it is for the tail area. In Krogowanan and Kalibawang, the highest farm income is estimated for the middle reach of the system.

The data show that the farm income is not only dependent on the size of landholding, but also on access to irrigation, cropping intensity and the tye of crop sown. For example, Kalibawang is characterized by small size of landholdings but land is used intensively with diversified cropping patterns. Farmers in this area have a higher farm income compared to those in Klambu Kiri, Glapan and Krogowanan systems.

In Klambu Kiri and Glapan, rice is the most important source of farm income while in Krogowanan and Kalibawang the important crops are soybean, peanut and chili (table 3.4.13). Soybean and peanut are grown during DS I and II when irrigation water is limited. Chili is also grown during DS I and II. These are cash crops and significantly contribute to the farm income.

Table 3.4.12. Total food crop income per ha per year ('000 Rp).

1. SYSTEM	Head	Middle	Tail
Klambu Kiri	11,997	8,904	6,382
Glapan	4,442	3,133	12,135
Krogowanan	7,604	13,851	5,646
Kalibawang	13,750	17,918	8,192

Source: Primary Data 2002.

Table 3.4.13. Percentage of crop income (%)..

Crops	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
1. Rice	78.26	52.25	70.61	90.97	69.34	90.00	29.52	32.96	86.18	38.97	66.32	57.33
2. Soybean		0.35	3.58							11.40	16.77	5.08
3. Chili		2.30	0.16				37.97	48.26	3.41	15.65	6.62	4.21
4. Peanut										3.12	3.22	0.16
5. Onion		42.04	10.05							14.96	6.13	3.70
6. Maize				0.96		0.02	0.00	4.33	2.25	5.14	0.20	3.04
7. Longbean							1.92	2.28	8.16	0.02		0.80
8. Mungbean	21.74	2.89	2.31	8.07	30.66	9.98				2.24	0.71	1.60
9. *Kc Tolo*										0.18	0.04	0.82
10. *Bw daun*							0.04			0.75		0.43
11. Cucumber							0.05			0.04		10.28
12.Mustard gr							0.03	0.19		0.76		9.88
13. Sweet potato										0.01		0.04
14. Cabbage							2.14	0.73				0.25
15. Water melon		0.17										1.89
16. Salacca								2.68		0.59		
17. Tobacco								0.09		0.97		
18. Egg plant										5.20		
19. Cl flower							20.33	3.71				
20. String bean							0.32					
21. Tomato							7.69	4.67				
22.Sugarcane			13.29									

Source: Primary Data 2002.

For all systems, food crop is the main source of household farm income (table 3.4.14). In Klambu Kiri, Glapan and Krogowanan, food crop income contributes more than 70 percent of the total household farm income. In Kalibawang where size of landholding is smaller, food crop income contributes less than 60 percent of the total farm income. Exceptionally in Glapan, income from food crops is higher at the middle area than at the tail and head reaches.

Perennial crops are generally planted in upland areas and backyards or home gardens. Contribution of these crops varies across the systems and locations, i.e., head, middle, and tail reaches. The highest contribution of perennial crop is found in Kalibawang system, i.e., 13.4 percent at the head reach, 4.5 percent at the middle reach and 10.94 percent at the tail reach.

In Kalibawang, livestock, especially cows and buffaloes, contribute 22.6 percent, 12.9 percent, and 33.5 percent at the head, middle tail reaches, respectively. In other systems, contribution of livestock is relatively low. For all systems, contribution of fish farming to total farm income is very small.

Sale of farm products is an important source of cash for the farmers in all systems. Rice is still the main source of cash for farmers in four systems (table 3.4.15). In Klambu Kiri, Glapan and Krogowanan, more than 50 percent of the total rice produced is sold while in Kalibawang where size of landholding is smaller the proportion is less than 50 percent. Proportion of other farm products sold is small except vegetables at the head reach of Krogowanan.

Table 3.4.14. Total farm income per year.

No.	Source	Head		Middle		Tail	
		(000 Rp)	%	(000 Rp)	%	(000 Rp)	**%**
A.	Klambu Kiri						
1.	Food crop	6,704	95.94	8,581	92.36	4,123	98.86
2.	Perennial Crop	82	1.18	151	1.63	0	0.01
3.	Livestock	185	2.66	543	5.85	29	0.72
4.	Fish	15	0.22	15	0.17	17	0.42
	Total	6,988	100.00	9,291	100.00	4,171	100.00
B.	Glapan						
1.	Food crop	2,792	94.24	3,394	73.94	11,492	96.87
2.	Perennial Crop	1046	3.53	595	12.98	143	1.21
3.	Livestock	66	2.23	561	12.24	227	1.92
4.	Fish	0	0,00	38	0.84	0	0.00
	Total	2,962	100.00	4,590	100.00	11,864	100.00
C.	Krogowanan						
1.	Food crop	2,184	73.39	5,087	84.69	2,268	85.31
2.	Perennial crop	160	5.38	391	6.52	234	8.82
3.	Livestock	630	21.19	244	4.07	110	4.15
4.	Fish	1	0.05	283	4.72	45	1.73
	Total	2,976	100.00	6,007	100.00	2,659	100.00
D.	Kalibawang						
1.	Food crop	2,925	62.63	4,352	82.52	2,243	54.79
2.	Perennial crop	644	13.81	237	4.51	448	10.94
3.	Livestock	1,054	22.58	678	12.86	1,371	33.49
4.	Fish	45	0.98	6	0.12	31	0.78
	Total	4,670	100.00	5,274	100.00	4,095	100.00

Source: Primary Data 2002.

Table 3.4.15. Percentage of sale of farm product (%).

Commodity	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
1.Rice	54.67	56.99	57.84	66.86	59.91	55.36	35.20	68.48	72.06	39.26	56.37	47.04
2.Maize		1.01	0.97	3.57			1.96	6.06	11.76	21.57	1.47	12.68
3.Sw Potato			0.97					2.73				
4.Soybean		1.01	13.59							41.96	57.75	35.58
5.Peanut		1.02								17.39	29.61	4.76
6.Mungbean	81.71	35.37	11.65	19.07	57.08	66.29				10.91	11.37	9.17
7.Sugarcane			0.92									
8.Vegetables		20.20	5.83				66.67	36.21	11.76	39.69	19.20	42.62
9.Coconut							5.88	8.79	10.59	32.13	12.75	31.79
10.Bamboo							0.98	4.55				1.19
11.Chicken	1.63	0.51		0.14	0.51		16.08	22.12	12.94	28.76	27.25	40.38
12.Cattle				0.83			5.88			12.17	5.88	10.71
13.Fish								6.06		2.61	1.96	1.19
14.Fruits	4.90	11.01		16.67	17.35	4.41	23.14	17.12	15.88	41.87	28.82	53.81

Source: Primary Data 2002.

Farm and off-farm jobs are available for farm households in all systems. Common off-farm jobs available in all systems are farm laborer, off-farm laborer, trading and services. Wives usually work as farm laborers and small traders while husbands work as off-farm laborers and service providers. Sometimes, adult children also work in farm and off-farm jobs. The opportunities in farm and off-farm jobs in all system are fairly similar.

Table 3.4.16 shows that farm income is generally the main source of income for the farmers in four systems. It contributes more than 50 percent to the total income, except for head of the Glapan system, tail of the Krogowanan system and middle of the Kalibawang system. In these locations contributions of farm income are 38.6 percent, 35.8 percent and 49.4 percent, respectively.

In Klambu Kiri, Krogowanan and Kalibawang systems, the highest farm income is estimated for the middle reach of the system while in Glapan, the highest farm income is estimated for the tail reach of the systems. The highest off-farm income received by farmers is estimated for the middle reach of the Klambu Kiri system while the lowest is estimated for the head reach of the same system. Similar to farm income, the highest total household income is estimated for the middle reaches of Klambu Kiri, Krogowanan and Kalibawang systems, and at the tail reach of the Glapan system.

Table 3.4.16. farm and off-farm income per household per year.

System	Location	Farm		Off-Farm		Total
		(000 Rp)	(%)	(000 Rp)	(%)	(Rp)
Klambu Kiri	H	6.988	79.29	1.825	20.71	8.813
	M	9.291	51.99	8.579	48.01	17.871
	T	4.171	56.18	3.253	43.82	7.424
Glapan	H	2.962	38.62	4.708	61.38	7.671
	M	4.590	54.33	3.858	45.67	8.448
	T	11.864	73.75	4.223	26.25	16.087
Krogowanan	H	2.976	44.60	3.697	55.40	6.674
	M	6.007	71.24	2.425	28.76	8.432
	T	2.659	35.79	4.770	64.21	7.429
Kalibawang	H	4.670	59.24	3.213	40.76	7.883
	M	5.274	49.38	5.405	50.62	10.680
	T	4.095	65.61	2.147	34.39	6.242

Source: Primary Data 2002.

Farm Household Expenditure

In the head reach of Klambu Kiri and the head as well as the middle reaches of Krogowanan, the proportion of food expenditure is still high, i.e., more than 50 percent, indicating that farm households in these reaches spend a significant part of their total expenditure on food consumption (table 3.4.17). In other areas, the proportion is about 40 percent or even 20 percent as in the tail reach of Glapan. In these areas, expenditures on education, health and housing are important components of the total household expenditures.

Table 3.4.17. Food and non food expenditure per year.

System	Location	Food		Non-food		Total
		(000 Rp)	(%)	(000 Rp)	(%)	(000 Rp)
Klambu Kiri	H	4.128	53.83	3.541	46.17	7.669
	M	5.476	45.67	6.514	54.33	11.991
	T	5.020	48.40	5.351	51.60	10.371
Glapan	H	4.274	43.77	5.491	56.23	9.765
	M	4.821	45.76	5.714	54.24	10.536
	T	5.211	26.41	14.520	73.59	19.731
Krogowanan	H	3.808	52.50	3.445	47.50	7.254
	M	4.346	52.34	3.958	47.66	8.304
	T	3.507	49.61	3.563	50.39	7.070
Kalibawang	H	3.506	47.01	3.952	52.99	7.458
	M	3.627	39.55	5.543	60.45	9.170
	T	2.975	45.95	3.500	54.05	6.476

Source: Primary Data 2002.

INCIDENCE OF POVERTY

Headcount Measure

In Klambu Kiri and Kalibawang, the highest income per capita was estimated for the middle reach of the system, while in Glapan and Krogowanan, the highest income per capita is estimated for the tail of the system (table 3.4.18). Except for the tail of Krogowanan, income per capita is mainly influenced by the total income, not by family size. In the tail of Krogowanan, the average family size is only 3.71 persons. Therefore, even though the total income of this area is second in ranking, income per capita is still the highest in the system.

Compared to the poverty line set up by the Center Bureau of Statistic (table 3.4.19) and suggested by Sayogyo (table 3.4.20), the income per capita in all systems is still much higher. However, it should be noticed that a large part of income received by farm households is in kind rather than in cash.

Table 3.4.18. Per capita income of farm household.

System	Location	Farm HH income (000 Rp)	Number of family member (person)	Per capita income (000 Rp/ year)	Per capita income (000 Rp / month)
Klambu Kiri	H	8,813	4.73	1,863	155
	M	17,871	4.83	3,700	308
	T	7,424	5.34	1,390	115
Glapan	H	7,671	5.30	1,447	120
	M	8,448	4.77	1,771	147
	T	16,087	4.75	3,386	282
Krogowanan	H	6,674	4.63	1,441	120
	M	8,432	4.61	1,829	152
	T	7,429	3.71	2,002	166
Kalibawang	H	7,883	4.33	1,820	151
	M	10,680	4.47	2,389	199
	T	6,242	4.60	1,357	113

Source: Primary Data 2002.

Table 3.4.19. Poverty line according to the criterion of Central Bureau of Statistics in 1999.

No.	System	Regency	Poverty Line (Rp / Capita / Month)
1.	Klambu Kiri	Demak	76,785
2.	Glapan	Grobogan	74,007
3.	Krogowanan	Magelang	79,358
4.	Kalibawang	Kulonprogo	84,062

Source: Central Bureau of Statistics, 2001.

Table 3.4.20. Poverty line according to the criterion of Sajogyo.

No.	Criterion	Measurement (Income in kg rice equivalent / person / year)	
		Rural	Urban
1.	Very Poor	< 240	< 360
2.	Poor	240 – 320	360 – 480
3.	Almost Poor	320 – 480	480 – 720
4.	Not Poor	> 480	> 720

Source: Review Subcomponent 1 Report, 2002.

Although the average income per capita is much higher than the poverty line, the number of poor farm households is still high in all systems and locations (table 3.4.21). At least 30 percent of the farm households in each system and location are poor. Comparison across locations shows that in Klambu Kiri and Kalibawang systems the highest number of poor farmer is found at the tail reach, while in Glapan and Krogowanan the highest number is at the head reach. According to Sayogyo’s criterion, the poor farm households in all systems are categorized as poor or almost poor. No farm households are characterized as very poor households.

Poverty is closely related to the size of the landholdings. The number of poor farm households increases with decrease in ownership of landholdings. More than 60 percent of the total farm households that own land less than 0.5 hectare each are considered poor, except in the tail area of Glapan. For the size of landholding between 0.5-1 hectare, the number of poor farm households is more than 18 percent, except in the tail area of Krogowanan and all locations of the Kalibawang system. In Klabu Kiri and Glapan systems, there are poor farm households that own more than 1 hectare of land.

Table 3.4.21. Percentage number of poor farm households.

Poverty criterion	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	**M**	**T**
BPS criterion												
- Poor people	36.73	36.36	56.31	46.43	32.35	35.29	47.06	45.45	29.41	36.52	33.33	40.48
- Not poor	63.27	63.64	43.69	53.57	67.65	64.71	52.94	54.55	70.59	63.48	66.67	59.52
Sajogyo's criterion												
- Very poor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
- Poor	16.25	6.74	7.69	5.48	10.34	17.46	6.67	6.90	0.00	14.14	16.67	23.29
-Almost poor	22.50	29.21	48.35	38.36	31.03	31.75	40.00	37.93	25.00	19.19	20.83	21.92
- Not poor	61.25	64.04	43.96	56.16	58.62	50.79	53.33	55.17	75.00	66.67	62.50	54.79
Landholding												
- < 0.5 ha	78.38	71.43	70.69	62.50	80.95	59.26	95.65	73.33	80.00	95.12	100.0	91.43
- 0.5 – 1.0 ha	18.92	25.71	20.69	22.50	19.05	25.93	4.35	20.00	20.00	4.88	0.00	5.71
- > 1.0 ha	2.70	2.86	8.62	15.00	0.00	14.81	0.00	6.67	0.00	0.00	0.00	2.86

Source: Analyzed from Primary Data 2002.

POVERTY GAP MEASURE

Table 3.4.22 shows that the poverty gap in the tail reach of the Klambu Kiri system is higher than that of the daily worker/landless and farmers in the rain-fed area. This indicates that the income of poor farm households in this area is far below the poverty line compared to the poor daily workers or poor farmers in the rain-fed area. Therefore, to lift poor farm households out of poverty in this area needs more resources compared to the same effort for poor daily workers and poor farmers in the rain-fed area. The situation for poor farm households in the middle of Glapan system and poor farmers in all areas of Krogowanan system is similar. The performance of the Kalibawang system is relatively better.

Squared poverty gap in the tail reach of Klambu Kiri is also higher than that of the daily workers and farmers in the rain-fed area. This means that income inequality among poor in this area is more serious than that among poor daily workers and poor farmers in the rain-fed area. A similar situation prevails in reaches of Glapan and Krogowanan systems.

Table 3.4.22. Poverty gap by system and location.

System	Head	Middle	Tail	Daily worker
Poverty gap				
• Klambu Kiri	0.19	0.25	0.38	0.27
• Glapan	0.31	0.36	0.25	0.83
• Krogowanan	0.27	0.25	0.23	0.17
• Kalibawang	0.15	0.17	0.17	0.27
• Rain-fed	0.33			
Squares poverty gap				
• Klambu Kiri	0.15	0.27	0.43	0.16
• Glapan	0.41	0.37	0.25	0.27
• Krogowanan	0.18	0.16	0.21	0.05
• Kalibawang	0.09	0.13	0.10	0.12
• Rain-fed	0.22			

Inequality Measure

Table 3.4.23 shows that income Gini ratio for households in all the four irrigation systems is higher than that for daily workers and farmers in the rain-fed area. This means that income distribution among farmers, both the poor and the nonpoor, in the irrigated area is more inequitable than that for daily workers and farmers in the rain-fed area. The values indicate that the income gap between the poor and the nonpoor farm households in the irrigated area is still wide.

Table 3.4.23. Gini ratio by system and location.

System	Head	Middle	Tail	Daily worker
Klambu Kiri	0.52	0.69	0.66	0.37
Glapan	0.58	0.55	0.78	0.37
Krogowanan	0.55	0.56	0.52	0.23
Kalibawang	0.49	0.55	0.41	0.48
Rain-fed	0.48			

3.5. DETERMINANTS OF POVERTY IN IRRIGATION SYSTEMS

Glapan System

Tables 3.5.1 and 3.5.2 show the results of logit and probit models for the Glapan system. The results show that there is a close relationship between size of irrigated area and farm labor use as important factors influencing poverty. In both logit and probit models, a significant effect of size of irrigated area is found only in the middle area. This is shown by the negative and significant coefficient of this variable in the model. In contrast, the significant effect of farm labor use is found in all areas except in the middle area as indicated by the negative and significant coefficient of this variable in the model. This indicates that the two factors actually have significant effects in reducing poverty. In the middle area, the size of irrigated area is the dominant factor while at the head and middle areas farm labor use is the dominant factor.

Although there are some differences in results between logit and probit models, in general, it can be said that nonfarm labor use such as small trader, motor cycle driver, construction laborer and so on has a significant effect on poverty. The effect of this variable is indicated by the negative and significant coefficient of nonfarm labor use in both logit and probit models. This result shows that the larger the nonfarm labor use the smaller the probability of farmers falling under poverty line. This also suggests that the proportion of nonfarm income in the total income is increasing over time

The distance of land area to source of water/water gate has no significant effect on poverty. However, the availability and sufficiency of irrigation water supply in every season especially at the tail reach is a more important factor affecting poverty. This is shown by the negative and significant coefficient of availability and sufficiency of irrigation water supply in both logit and probit models. This indicates that the greater the availability and sufficiency of irrigation water supply the smaller the probability of farmers falling under the poverty line.

The farm household income earned from the irrigated area has a substantial effect in reducing poverty as indicated by the negative and significant coefficient in both logit and probit models. The dummy coefficient for the middle area has significant and negative signs. This indicates that the probability of farmers in the middle area falling under the poverty line is smaller than that for farmers in the head area. However, comparison between head and tail areas as indicated by the coefficient of dummy variable for the tail area does not indicate the effect of location on poverty. This indicates that the effect of irrigation system performance on poverty is not only determined by location in the system but also by other factors, such as availability and sufficiency of irrigation water supply as mentioned earlier.

Table 3.5.1. Factors affecting poverty for Glapan system using logit model.

No.	Variable	Glapan	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.12995	-0.24770E-01	-0.77673***)	-0.10395
2	Farm labor use (man-days)	-0.82894E-02***)	-0.12596E-01**)	0.52269E-03	-0.74096E-02*)
3	Nonfarm labor use (man-days)	0.91192E-03	-0.46533E-02***)	-0.40457E-02**)	-0.39768E-02**)
4	Distance to water gate (m)	-0.47562E-04	-0.10436E-03	-0.41626E-03	0.15886E-03
5	Availability of water supply	-0.15331E-01	0.40147	0.44508	-1.5483**)
6	Time accuracy of water supply	-0.30752E-01	-0.39756	-0.15342	1.8376***)
7	Sufficiency of water supply	-0.69287E-01	0.23680E-01	-0.75250E-01	-1.6001***)
8	Farm income (000Rp/ha)	-0.10281E-02***)	-0.16252E-02***)	-0.53202E-03***)	-0.13192E-02***)
9	Farm production (000Rp/ha)	0.58913E-03***)	0.77223E-03**)	0.19675E-04	0.10482E-02**)
10	Dummy for middle area	-1.1344***)			
11	Dummy tail for tail area	-0.53201			
	Constant	1.5595	2.3023*)	1.2039	0.26174

***)significant at 1% level.
**) significant at 5% level.
*) significant at 10% level.

Table 3.5.2. Factors affecting poverty for Glapan system using probit model.

No.	Variable	Glapan	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.73947E-01	0.14668E-01	-0.47181***)	-0.44848E-01
2	Farm labor use (man-days)	-0.51204E-02***)	-0.79115E-02**)	0.41304E-03	-0.74746E-02**)
3	Nonfarm labor use (man-days)	-0.20256E-02***)	-0.27152E-02	-0.24158E-02**)	-0.24590E-02**)
4	Distance to water gate (m)	-0.25053E-04	-0.52034E-04	-0.25666E-03	0.10645E-03
5	Availability of water supply	-0.27481E-01	0.20211E-01	0.27357	-0.92699**)
6	Time accuracy of water supply	-0.14700E-01	-0.26223	-0.83674E-01	1.0910***)
7	Sufficiency of water supply	-0.32639E-01	0.11188	-0.49219E-01	-0.96282***)
8	Farm income (000Rp/ha)	-0.62275E-03***)	-0.93393E-03***)	-0.32286E-03***)	-0.78181E-03***)
9	Farm production (000Rp/ha)	0.36510E-03***)	0.50799E-03***)	0.81351E-05	0.62182E-03**)
10	Dummy for middle location	-0.69427***)			
11	Dummy for tail location	-0.31503			
	Constant	0.92835**)	1.4509*)	0.70295	0.62182E-03

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Kalibawang System

Tables 3.5.3 and 3.5.4 show results of logit and probit models for the Kalibawang system. In all areas of the system, the size of irrigated land area significantly affects poverty. The negative and significant coefficient of this variable in the model indicates that the larger the size of irrigated area the smaller the probability of farmers falling under the poverty line. Actually, the average size of landholding in all locations of the Kalibawang system is relatively smaller compared to that in other systems. With high cropping intensity and high economic value of crops planted, accompanied by a good irrigation system, the small size of land could generate a higher income for the farmers to escape poverty. In contrast to the Glapan case, the effect of size of irrigated area on poverty in the Kalibawang system is more dominant than farm-labor use. This is indicated by the negative and significant coefficient of farm labor use only for the head area and the negative and significant coefficient of size of irrigated area for all areas.

Like the Glapan case, the effect of nonfarm labor use on poverty is found in all areas. The effect of this variable is indicated by the negative and significant coefficient of nonfarm labor use in both logit and probit models. This relationship shows that the larger the nonfarm labor use the smaller the probability of farmers falling under poverty line. With the relatively small size of landholding farmers in the Kalibawang system have adequate opportunities to work in the nonfarm sector. Small trading, carpentry, construction labor and so on are nonfarm occupations that are common in the Kalibawang system.

Distance of land area to source of water/water gate has no significant effect on poverty. Sufficiency of irrigation water supply in every season especially in the middle reach is a more important variable affecting poverty. This is shown by the negative and significant coefficient of this variable in both logit and probit models. This indicates that the probability of farmers falling under the poverty line is reduced with sufficiency of irrigation water supplies.

Farmer income derived from irrigated area has a substantial effect in reducing poverty as indicated by the negative and significant coefficient of farm income in both logit and probit models. This is easy to understand since a large part of income of farmers in the Kalibawang system is still dominated by income generated by irrigated land area.

Coefficients for dummy variables for middle and tail areas have significant and negative signs. This indicates that the probability of farmers in the middle area falling under the poverty line is smaller than that of farmers in the head area. However, the comparison between head and tail area as indicated by the coefficient of dummy variable for the tail does not indicate any different effect on poverty due to different locations. This indicates that the effect of irrigation system performance on poverty is not only determined by area in the system but also by other factors, mainly sufficiency of irrigation water supply as mentioned earlier.

Table 3.5.3. Factors affecting poverty for the Kalibawang system using the logit model.

No.	Variable	Kalibawang	Head	Middle	Tail
1	Size of irrigated area (ha)	-1.0828***)	-0.96267*)	-1.5049 ***)	-1.1321*)
2	Farm labor use (man-days)	-0.23772E-02	-0.78140E-02*)	-0.32967E-02	0.27738E-02
3	Nonfarm labor use (man-days)	-0.44970E-02***)	-0.67685E-02***)	-0.76049E-03	-0.41343E-02***)
4	Distance to water gate (m)	0.10327E-05	-0.10652E-04	0.37309E-03	-0.85455E-03
5	Availability of water supply	-0.16256	0.19528E-03	0.63667 *)_	0.12300
6	Time accuracy of water supply	0.18086	-0.88235E-01	0.44122	0.71501E-01
7	Sufficiency of water supply	0.10824	-0.24095	-0.65372*)	0.32027
8	Farm income (‘000Rp/ha)	-0.39206E-01	-0.87568E-03***)	-0.39458E-03***)	-0.72987E-03***)
9	Farm production (000Rp/ha)	-0.49209E-01	0.66138E-03***)	0.22648E-03*)	0.25870E-03
10	Dummy for middle area	-0.69028E-03***)			
11	Dummy for tail area	0.40956E-03***)			
	Constant	0.29369	0.75457	-0.92116	0.22105

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Table 3.5.4. Factors affecting poverty for Kalibawang system using the probit model.

No.	Variable	Kalibawang	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.63599***)	-0.57575*)	-1.5049***)	-0.63561*)
2	Farm labor use (man-days)	-0.14864E-02	-0.47008E-02*)	-0.32967E-02	0.15810E-02
3	Nonfarm labor use (man-days)	-0.25791E-02***)	-0.39661E-02***)	-0.76049E-03	-0.24466E-02***)
4	Distance to water gate (m)	0.12472E-05	-0.48224E-05	0.37309E-03	-0.43198E-03
5	Availability of water supply	-0.82072E-01	0.31675E-02	0.63667*)	0.82153E-01
6	Time accuracy of water supply	0.13393	-0.59380E-01	0.44122	0.51896E-01
7	Sufficiency of water supply	0.52591E-01	-0.14446	-0.65372*)	0.18111
8	Farm productivity (’000Rp/ha)	-0.25686E-01	-0.51596E-03***)	-0.39458E-03***)	-0.42495E-03***)
9	Farm income (’000Rp/ha)	-0.33201E-01	0.39044E-03***)	0.22648E-03*)	0.15000E-03
10	Dummy for middle area	-0.40582E-03***)			
11	Dummy for tail area	0.24573E-03***)			
	Constant	0.16425	0.45249	-0.92116	0.82449E-01

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Klambu Kiri System

Tables 3.5.5 and 3.5.6 show the results of logit and probit models for the Klambu Kiri system. In all areas of the system, the size of irrigated land area significantly affects poverty. The negative and significant coefficient of this variable in the model indicates that the larger the size of the irrigated area the smaller the probability of farmers falling under the poverty line. The effect of farm labor use on poverty is only found in the tail area. This is indicated by the negative and significant coefficient of farm labor use in the model. As in the Kalibawang case, the effect of the size of irrigated area on poverty in Klambu Kiri is more dominant than that of farm labor use. This is indicated by the negative and significant coefficient of farm labor use only for the tail area and the negative and significant coefficient of size of irrigated area in all areas.

The effect of non-farm labor use on poverty is found only in the middle area. The effect of this variable is indicated by the negative and significant coefficient of non-farm labor use in both logit and probit models. This relationship shows that the larger the non-farm labor use the smaller the probability of farmers falling under the poverty line. The same effect is found for Klambu Kiri system as a whole as indicated by the negative and significant coefficient of nonfarm labor use in the model. Rural nonfarm job opportunities, such as small trader, carpenter, construction laborer and so on are taken up by farmers in the Klambu Kiri system. The availability of water at the tail reach and timeliness of supplies also have effects on poverty.

As in the Glapan and Kalibawang systems, farm household income derived from irrigated area has a substantial effect in reducing poverty as indicated by the negative and significant coefficient of farm income in both legit and probity models. As in the Glapan and Kalibawang case, a large part of farm household income in the Klambu Kiri system is still dominated by income generated by the irrigated area.

The coefficient of the dummy variable for the middle area is found negative and significant indicating that the probability of farmers in the middle area falling under the poverty line is lower than that of farmers in the head area. The coefficient of the dummy variable for the tail area is found positive and significant, which indicates that the probability of farmers in the tail area falling under the poverty line is higher than that of farmers in the head area.

Table 3.5.5. Factors affecting poverty for the Klambu Kiri system using the logit model.

No.	Variable	Klambu Kiri	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.56466***)	-1.1018***)	-0.83109***)	-0.35536**)
2	Farm labor use (man-days)	-0.29459E-02*)	-0.24148E-02	0.88578E-03	-0.63368E-02*)
3	Non-farm labor use (man-days)	-0.17363E-02***)	-0.25711E-02	-0.41500E-02***)	0.85720E-03
4	Distance to water gate (m)	-0.42292E-03***)	-0.63718E-03***)	-0.26799E-03	0.43405E-03
5	Availability of water supply	-0.29240	1.0183*)	-0.24665E-01	-0.60124*)
6	Time accuracy of water supply	0.36159	-0.82718*)	0.66163E-01	0.32220
7	Sufficiency of water supply	-0.86768E-01	0.60978**)	-0.81505E-01	0.12787E-01
8	Farm income (000Rp/ha)	-0.11922	-0.59579E-03***)	-0.10464E-02***)	-0.48095E-03***)
9	Farm production (000Rp/ha)	0.19376	0.15630E-03	0.27351E-04	0.31517E-03***)
10	Dummy for middle area	-0.47901E-03***)			
11	Dummy for tail area	0.22166E-03***)			
	Constant	1.5758***)	1.7524	3.2437***)	1.2325*)

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Table 3.5.6. Factors affecting poverty for Klambu Kiri system using the probit model.

No.	Variable	Klambu Kiri	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.56466***)	-0.64767***)	-0.47483***)	-0.20508**)
2	Farm labor use (man-days)	-0.29459E-02*)	-0.16198E-02	0.64646E-03	-0.37381E-02*)
3	Nonfarm labor use (man-days)	-0.17363E-02***)	-0.13866E-02	-0.22750E-02***)	0.58292E-03
4	Distance to water gate (m)	-0.42292E-03***)	-0.37232E-03***)	-0.17138E-03	0.20339E-03
5	Availability of water supply	-0.29240	0.59112*)	0.45930E-01	-0.37319*)
6	Time accuracy of water supply	0.36159	-0.51289*)	0.24873E-01	0.18751
7	Sufficiency of water supply	-0.86768E-01	0.37265***)	-0.72989E-01	0.14209E-01
8	Farm productivity (000Rp/ha)	-0.11922	-0.34458E-03***)	-0.59580E-03***)	-0.27912E-03***)
9	Farm income (000Rp/ha)	0.19376	0.93612E-04	0.15378E-04	0.18452E-03***)
10	Dummy for middle area	-0.47901E-03***)			
11	Dummy for tail area	0.22166E-03***)			
	Constant	1.5758***)	1.0643	1.7881***)	0.74446*)

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Krogowanan System

Tables 3.5.7 and 3.5.8 show the results of the logit and probit model for the Krogowanan system. The significant effect of size of irrigated area is found only in the head area while in other areas this variable does not have a significant effect. Except for the Krogowanan system as a whole, farm labor use has an insignificant effect on poverty. Nonfarm labor use and farm income significantly affects poverty in the head area. The coefficient for the dummy for the middle area is significant, indicating that the probability of farmers in the middle areas falling under the poverty line is higher than that of farmers in the head area. Other factors have an insignificant effect on poverty.

Table 3.5.7 Factors affecting poverty for Krogowanan system using the logit model.

No.	Variable	Krogowanan	Head	Middle	Tail
1	Size of irrigated area(ha)	-1.1839	-1.9296**)	-2.5811	-28.765
2	Farm labor use (man-days)	0.11119E-04***)	0.11963E-04	-0.67827E-02	-0.73689E-01
3	Nonfarm labor use (man-days)	-0.78609E-02	-0.10949E-01***)	-0.11761E-01	0.37019E-01
4	Distance to water gate (m)	0.34032E-04***)	0.36052E-04	0.67659E-02	0.12637E-02
5	Availability of water supply	1.6290	-0.53961	-3.6899	32.548
6	Time accuracy of water supply	-1.6527	0.52544	7.9023	-30.441
7	Sufficiency of water supply	-0.67856***)	-0.17117	-0.91304	-10.734
8	Farm income (000Rp/ha)	1.5635*)	-0.93717E-03***)	-0.42215E-02	0.33383E-01
9	Farm production (000Rp/ha)	-0.25322	0.38355E-03	0.19116E-02	-0.42099E-01
10	Dummy for middle area	-0.84737E-03***)			
11	Dummy for tail area	0.63402E-04			
	Constant	0.23383	2.0947	-4.8917	99.909

***) significant at 1% level
**) significant at 5% level
*) significant at 10% level

Table 3.5.8. Factors affecting poverty for Krogowanan system using the probit model.

No.	Variable	Krogowanan	Head	Middle	Tail
1	Size of irrigated area (ha)	-0.69395***)	-1.1393***)	-1.4869	-6.5786
2	Farm labor use (man-days)	0.51042E-05	0.56184E-02	-0.37045E-02	-0.21500E-01
3	Nonfarm labor use (man-days)	-0.46741E-02***)	-0.66112E-02***)	-0.66048E-2	0.80882E-02
4	Distance to water gate (m)	0.19406E-04	0.21787E-04	0.35723E-02	0.38218E-03
5	Availability of water supply	0.92867***)	-0.34803	-2.0854	12.876
6	Time accuracy of water supply	-0.92360*)	0.34784	4.58	-9.8555
7	Sufficiency of water supply	-0.41503	-0.10367	-0.51822	-3.0889
8	Farm income (000 Rp/ha)	0.95329	-0.55678E-03***)	-0.24623E-02	0.87672E-02
9	Farm production (000 Rp/ha)	-0.16866**)	0.22309E-03	0.11125E-02	-0.11242E-01
10	Dummy for middle area	-0.50344E-03			
11	Dummy for tail area	0.39743E-04***)			
	Constant	0.13607	1.2551	-3.0237	19.370

***) significant at 1% level; **) significant at 5% level; *) significant at 10% level.

Conclusions

The results of the study suggest that poverty is a serious problem in the studied irrigation systems. The headcount measure shows that more than 30 percent of farm households in the irrigation systems live below the poverty line or are poor. The income gap measure shows that the gap between income of poor farm households and the poverty line is still wide and squared poverty gap measure shows that inequality in income distribution among poor farmers is high. Moreover, inequality in income distribution between both poor and not poor farmers is wide.

Poverty in irrigated area is not only determined by an irrigation factor, which is measured in terms distance to water gate, availability of water supply, timeliness and sufficiency of water supply, and farm location in the system but also by other factors. Results of the study show that the size of landholding, employment opportunities both in farm and nonfarm sectors, farm income and farm productivity are more dominant in affecting poverty than irrigation. This means that improving irrigation performance alone is not sufficient to lift the poor in the irrigated area.

Efforts to lift poor farm households out of poverty should focus on both irrigation and nonirrigation factors. The efforts related to irrigation can be in the form of crop diversification and crop intensification supported by improving irrigation water distribution. Crop diversification is performed through the introduction of high economic value crops, which are suitable for the area. Intensification can be done by increasing cropping intensity and productivity and applying appropriate amounts of other inputs. Efforts should also be made to expand the nonfarm sector, which depends on agriculture, such as promoting small-scale agro-industry.

3.6. IRRIGATION SYSTEM PERFORMANCE: IMPLICATIONS FOR THE POOR

Performance of an irrigation system affects the benefits received by farmers. Low level of performance leads to reducing farmers' income, which affects their welfare. On the other hand, farmers with low income and low level of welfare have limited capacity to manage their irrigation system so that the level of performance of the system declines. This creates a vicious circle of low performance and poverty. In an irrigation system with a low level of performance, the poor farmers may suffer more than nonpoor farmers because they have less access to resources, pushing the poor into deeper poverty. This chapter is aimed at assessing irrigation system peformance, relating the system performance to poverty, and examining poverty reduction impacts of system performance improvement.

Performance Indicators

Water Supply Performance

An irrigation system with a certain level of O&M interacts with its environment and produces a certain quantity of water supply. This level is measured by using water supply indicators. The values of the indicators for selected systems are presented in table 3.6.1.

Because of the deterioration of the ecosystem in its catchment area, erosion occurs in the upper part of the Jratunseluna river basin, which consists of five main rivers, namely Jragung, Tuntang, Serang, Lusi and Juana. Serang is the main water resource of the Klambu Kiri system while Tuntang is the main water source of the Glapan system. The erosion results in the sedimentation within the Klambu Kiri and Glapan system that, in turn, affects water allocation and distribution at the field level.

In Klambu Kiri, the values of RWS and RIS show that water is inadequate in the system. It is also shown in figures 3.6.1 and 3.6.2 that RWS and RIS of Klambu Kiri are inadequate. In the third planting season, which coincides with the dry season, available water is less than 20 percent of the requirement. The higher value of RWS compared to RIS shows that rainfall plays an important role in providing water to fulfill the crop water requirement.

Table 3.6.1. Water supply indicators of selected schemes.

Indicators	Planting season	Klambu Kiri	Glapan		Kalibawang			Krogowanan
			West Glapan	East Glapan	Kalibawang	Pengasih	Pekik Jamal	
Relative Water Supply (RWS)	RS	0.9815	1.2571	0.7532	1.5303	1.7831	1.7983	1.9060
	DS 1	0.9897	1.2884	1.1222	1.7497	1.4435	1.6578	1.7147
	DS 2	0.1776	0.5214	0.5872	2.2304	1.9389	2.0130	1.5544
Relative Irrigation Supply (RIS)	RS	0.7532	0.4301	0.5199	1.3033	0.9355	1.3001	1.2277
	DS 1	0.5642	0.4578	0.6929	1.3560	0.8767	1.2190	1.2100
	DS 2	0.1061	0.1157	0.4047	1.8475	1.4029	1.5832	1.3603
Water Delivery Capacity (WDC)		0.1412	0.0711	0.1800	0.7225	0.4416	0.1794	0.7952
Water Delivery Performance (WDP)	RS	2.8390	1.6521	1.8274	6.0505	2.2120	4.1694	3.5047
	DS 1	2.0425	1.7737	2.6305	10.4276	2.1095	4.6974	4.0141
	DS 2	0.5975	0.6575	1.4557	12.5505	3.4488	3.8838	8.8629
Overall System Efficiency (OPE)	RS	1.1502	1.9375	1.6028	0.6394	0.8908	0.6410	0.6788
	DS 1	1.4551	1.8205	1.2026	0.6145	0.9506	0.6836	0.6887
	DS 2	1.9551	3.5205	2.0589	0.4511	0.5940	0.5263	0.6126
Head-Tail Equity (HTERW)	RS	2.5267	2.6617		1.4512			
	DS 1	1.7179	3.0118		2.2199			
	DS 2	1.0671	2.5069		3.2315			

Likewise in Glapan, the value of RIS and RWS indicate that water is generally inadequate. In the first planting season when land preparation starts, rainfall is still low and irrigation requirement is high. Nevertheless, water supply, which is also fluctuating, is still inadequate to fulfill the requirements. In the third planting season, when rainfall stops and water availability in the Tuntang river falls down, farmers experience water shortage.

Figure 3.6.1. Relative irrigation supply of selected irrigation systems.

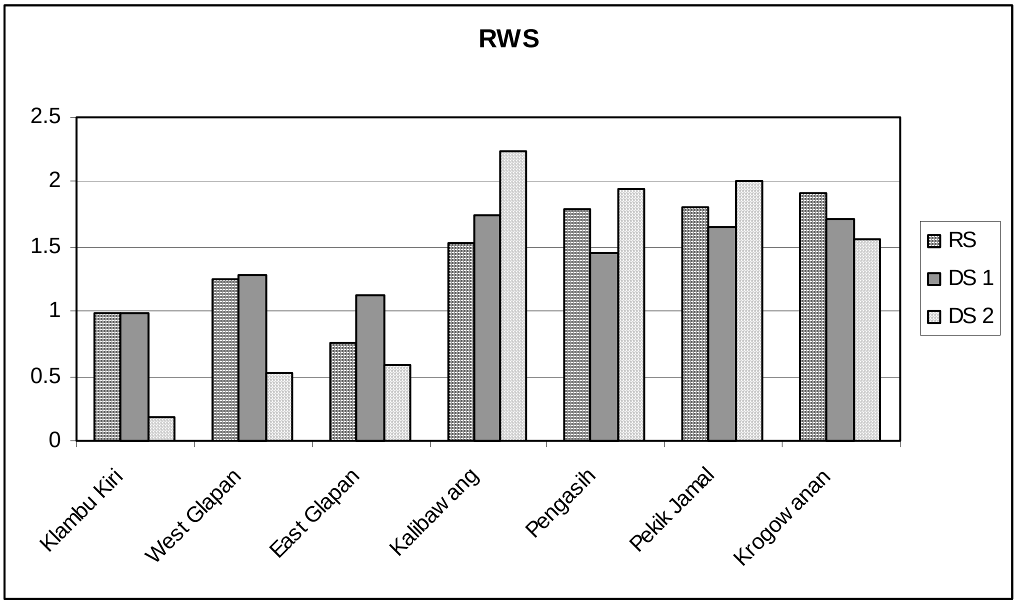
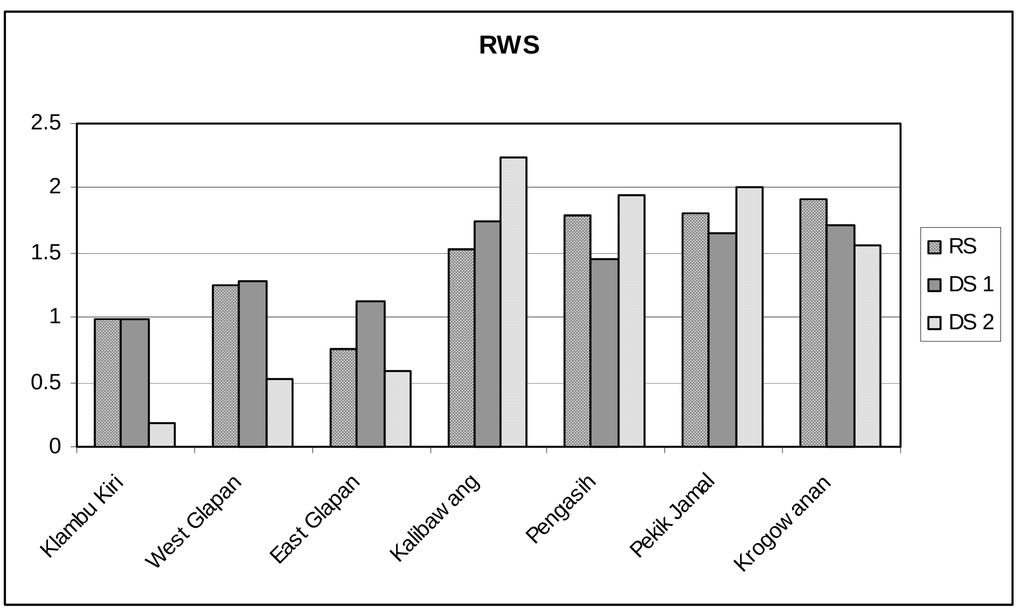


Figure 3.6.2. Relative water supply of selected irrigation systems.



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In general, West Glapan is more responsive to rainfall than East Glapan as shown in the value of RIS and RWS. Although RIS of both schemes is similar, the value of RWS in West Glapan can reach unity unlike RWS of East Glapan. This means that members of the O&M staff in West Glapan account for rainfall in their operational practice.

An additional problem in the Glapan system is garbage disposal along its canal network because the canal flows through the urban area and the big market. Even though such efforts as construction of garbage control and canal cover have been undertaken, they still fail to overcome the problem.

Glapan was developed during the Dutch Colonial Era in the 1930s. To improve the performance of the Glapan irrigation system, a major rehabilitation took place in 1976. The Glapan weir is situated in the Grobogan district and its irrigated area is spread throughout the Grobogan and Demak districts.

The irrigated area across two different districts becomes a problem in the Glapan system in this political reform era. The reform in Indonesia, which leads to local autonomy, allows the district government to manage its own business. However, the reform resulted in declining of O&M in the Glapan system. In the Grobogan district, housing and infrastructural office does not assign staff based on their capability and experience. For example, O&M of the Glapan system now become the responsibility of staff that have no background in O&M of the irrigation system. In the Demak district, which is located in the tail, farmers receive less water of late. Farmers argue that the management by BPSDA (water resources management body in a river-basin level), an autonomous board accountable to the national government provides more satisfaction. The reduction in water received by Demak farmers recently may happen due to: a) reduction in overall irrigation water availability, b) disappointed management by staff at district level, and c) inequity in water allocation and distribution.

In fact, members of the O&M staff of the Klambu Kiri system have made efforts to fulfill crop water requirements in the system. The value of WDP shows that water is delivered twice higher than its target, especially in the rainy season. In this case, members of the O&M staff anticipate losses along the canal. Hence, they deliver more water than its calculated target.

Although the WDP value shows that the Klambu Kiri system is able to fulfill its target demand, farmers still experience an inadequate water supply. According to the survey, in RS, 2.0 percent, 18.18 percent, and 14.57 percent respondents in the head, middle and tail reaches, respectively, receive inadequate water. The number is even higher for DS 1, at 18.36 percent, 31.07 percent, and 27.36 percent for head, middle and tail reaches, respectively.

Efforts to improve the performance in the Klambu Kiri and Glapan systems may face a constraint in that canal capacity is inadequate. The design capacity of the Klambu Kiri and Glapan main canal is inadequate to supply water for peak consumptive demand, which takes place in the third planting season as indicated by the WDC value. Unfortunately, the sedimentation in the canal reduces canal capacity. The value of WDP shows that canal capacity is limited to fulfill even a half of peak consumptive demand. This may be because of inappropriate design. If the canal is forced to flow more, it will be damaged and spill water out. However, in the third planting season, water is unavailable in the river to supply crops in the system. Therefore, canal capacity will have less serious problem in the system.

The percentage of farmers who suffer from inadequate water supplies is increasing at the tail end. Supply to tail end is decreasing because of illegal pumping along the main canal in the head reach of the system. Head-Tail Equity Ratio (HTERW), which is more than 1, indicated inequity in the distribution of water.

Besides inadequacy, another problem faced by farmers in the Glapan system is the unreliability of irrigation supplies. In the RS, 2.38 percent, 13.25 percent, and 48.17 percent of respondents at the head, middle and tail reaches, respectively, complain that irrigation supply is untimely. The situation is even worse in DS1 and DS2.

The value of HTERW of the Glapan system is more than 2, which shows significant head-to-tail inequity in water distribution. Factors that affect inequity are losses along the main canal, water theft, sedimentation and potential conflicts in management between BPSDA and the district-level government. In addition, coordination between the governments of Grobogan and Demak districts is weak.

The value of OPE for Glapan and Klambu Kiri systems, which is more than one, does not mean that the systems are very efficient. It just shows that water is inadequate indicating that total inflow into the canal system is less than the crop water requirement. Actually, some tertiary blocks in the tail end receive no water or very little water. Because OPE illustrates the overall efficiency, it does not indicate what happens within the systems. However, HTERW clearly shows that the tail part receives less water than the head, as discussed earlier.

Another problem faced in the Glapan system is that there are no tertiary canals in some tertiary blocks. Consequently, irrigation water does not reach some agricultural fields.

The Krogowanan system is located in the slope of Mount Merapi with such characteristics as porous soils, sloppy area and abundant water. Plentiful water availability is shown in the values of RIS and RWS. The high value of RIS and RWS and the low value of OPE do not mean inefficiency although they show that the water supply is more than the irrigation requirement. Surplus water is drained to tributaries to supply downstream systems. From the wider perspective, outflow from the Krogowanan system becomes inflow to other systems.

The actual volume of water supply is even higher than that recorded to calculate water supply indicators because several springs continuously supply unmeasured volume of water to the Krogowanan system. However, as a result of abundant supplies, farmers do not follow the specified cropping patterns. Farmers choose their own crops and planting date as they wish although they register different crops at the beginning of the first planting season. This causes differences in the target amount of water and the actual delivered amount as indicated in WDP value.

The Krogowanan system has an adequate canal capacity to fulfill the crop water requirement as shown in the WDC value that is equal to 1, indicating appropriateness of system design.

Although at the system level, water is abundant in Krogowanan, some farmers experience inadequacy of water supplies. Also, due to topographic conditions in the system, which is undulating in some areas, water distribution is not uniform. Moreover, in the Krogowanan system, the operational procedure works improperly. As a responsible party to irrigation operation after the IMT, WUAF let water be distributed without proper operational procedures.

Irrigation water in the Kalibawang system is considered adequate as illustrated in RIS and RWS indicators as shown in figures 3.6.1 and 3.6.2. These figures show that RIS and RWS are above 1, indicating adequacy of water supplies. In the three selected schemes, RIS and RWS are more or less equal to unity. In general, water availability is higher in the Kalibawang scheme than that of the Pengasih and Pekik Jamal schemes. Table 3.6.2 shows the respondent opinion on the performance of the Krogowana system.

Table 3.6.2. Respondent opinion on the performance of the Krogowanan system.

No.	Variable	Planting season	Percentage		
			Head	Middle	Tail
1	Inadequate	II	17.84	18.18	29.41
		III	12.77	15.63	41.18
2	Unreliable	II	4.84	21.12	41.18
		III	32.00	43.76	52.94
3	Abundant	II	23.53	15.15	5.88
		III	18.00	18.75	0.00

Although water supply is adequate, it is not equally distributed, especially in the third planting season. In the scheme, head-area farmers sometimes break the planting pattern by growing rice, when upland crop is planned. As a result, they divert much more water than the requirement for the upland crop. This can also explain the value of WDP. WDP is higher in the third planting season since the target is calculated based on water requirement of upland crops.

Efficiency of the Kalibawang system ranges between 40 percent and 95 percent. However, available data do not help trace the source of losses because it is insufficient to compute distribution, conveyance and application efficiency. OPE of the Kalibawang schemes is low because farmers are accustomed to take much water as their location at the head of the system and drainage is no problem. In Pekik Jamal, because the reliability is low, farmers try to hoard water to their field, and the efficiency is low.

Drainage problems occur in some parts of the Kalibawang system, especially during the first planting season. Respondents in the head, middle and tail suffering from drainage problem in RS are as many as 60.78 percent, 54.55 percent, and 41.18 percent, respectively. Additionally, canal capacity is inadequate to pass the peak consumptive demand.

Productivity Indicators

Productivity indicators for selected irrigation systems are presented in table 3.6.3. Compared to the other systems, Klambu Kiri has the lowest cropping intensity (CI) and irrigation intensity (II). In each planting season, a few parts are not cultivated and irrigated. Even in the third planting season, only 70 percent of the design command area is irrigated. Due to limited irrigated area, cultivated area is also limited.

As in Klambu Kiri, CI and II of the Glapan system is lower than 3. There are parts of command area that are not cultivated and irrigated. Generally, the East Glapan scheme shows better performance in terms of productivity than West Glapan although its water supply performance is not quite good. Additionally, CI of East Glapan is higher than that of West Glapan; II equals to CI means that the whole cultivated area of East Glapan is irrigated.

In Krogowanan, CI and II do not show an optimum value. Actually, all rice fields in the Krogowanan system are cultivated but its area is less than the design command area. Land conversion from agriculture to other purposes, especially at the tail end that is located along the provincial road, has reduced the command area. In addition, the low II does not mean inadequacy of water to irrigate agriculture because II does not show irrigation water from unmeasured springs within the Krogowanan system.

CI and II values for the Kalibawang system show an optimum performance of the system. Almost the whole command area is cultivated three times a year and almost all of them are irrigated. The Pekik Jamal Scheme, which is located at the tail of the system, shows the best performance with highest CI and II.

The values of OCW and ODW indicate productivity of water in the system. Water productivity has a correlation with irrigation adequacy, which is indicated by RIS and RWS. In such a system where water is inadequate as the Klambu Kiri and Glapan systems, ODW is higher than OCW. This shows that diverted water is less than the consumed water to produce the output. On the contrary, in such systems as the Krogowanan and Kalibawang systems, where water is adequate, OCW is higher than OCW. This reveals that additional water diverted, which is not consumed, cannot be used to increase productivity.

Table 3.6.3. Productivity indicators of selected irrigation systems.

Indicators	Planting season	Klambu Kiri	Glapan		Kalibawang			Krogowanan
			West Glapan	East Glapan	Kalibawang	Pengasih	Pekik Jamal	
Irrigation Intensity (II)		2.4960	1.9020	2.8912	2.8925	2.7200	2.9472	2.0219
Cropping Intensity (CI)		2.5250	2.7492	2.8912	2.9635	2.9339	3.000	2.6397
Output (rice) per unit area (OCOA) (ton/ha)	RS	4.48	5.25	3.39	4.28	5.97	4.05	3.36
	DS 1	3.45	3.79	3.35	3.41	4.63	3.26	2.86
Output per unit of diverted water (ODW) (kg/m^3)	RS	0.4044	1.2260	1.4469	0.2091	0.8140	0.2438	0.4463
	DS 1	0.4643	0.8831	0.9427	0.2280	0.3828	0.1710	0.1931
Output per unit of consumed water (OCW) (kg/m^3)	RS	0.3584	0.6196	0.8873	0.5151	0.8972	0.3733	0.6408
	DS 1	0.3124	0.4793	0.7755	0.5367	0.3927	0.1748	0.2797

Water productivity in one system differs from another as a result of interaction among several inputs in the agriculture system as well as interaction between a system and its environment. Water productivity is the lowest in the Kalibawang and Pekik Jamal schemes while it is the highest in the Glapan system. Therefore, it is difficult to compare water productivity across systems. However, it is possible to compare water productivity between the RS and DS 1 for the same crop, which is rice, with the assumption that within the system similar inputs are used in the two planting seasons.

In the Kalibawang and Krogowanan systems, more available water can increase production per unit water. In the systems where water is adequate, more water can stimulate the use of other inputs to produce more output. In the Glapan system, less water in the RS produces more output per unit of water compared to DS 1. In the systems where water is inadequate, it is utilized more efficiently with other agricultural inputs.

Environmental Indicators

Environmental indicators indicate how the physical environment interacts with irrigation systems so the system performs at a certain level. In general, performance of irrigation systems in terms of environmental indicators is good. Problems of physical environment occur in a few parts of the systems. The environmental indicators of selected irrigation systems are presented in table 3.6.4.

There is no natural environmental problem in Krogowanan. Conditions related to water, soils and topography are conducive for agriculture. Soil texture allows good drainage, with no problem of waterlogging. Salinity also appears nowhere in the Krogowanan system. The only environmental problem in this system is chemical pollution at the tail area where a pulp factory is located. Farmers informed that the pollution started more or less 10 years ago when the factory changed its main activities from producing paper from rice straw to recycling waste paper.

In the Kalibawang system, the upper scheme (Kalibawang), has the most accommodating physical environment. There is no problem of salinity or waterlogging. The middle scheme, Pengasih, experiences waterlogging in a few parts of its command area, especially at its tail end during the rainy season. Some parts experience salinity in the command area nearby the coastline during the dry season. Likewise in Pekik Jamal, the tail scheme, some parts of the command area suffer from salinity during the dry season and waterlogging during the rainy season. The waterlogging problem in Pekik Jamal is severer than that in Pengasih. To overcome the waterlogging problem, farmers make use of the *surjan* system. In the field with *surjan*, a part of the land is higher than the other part. Rice, which is more resistant to waterlogging, is grown in the lower part while vegetables or upland crops are grown in the upper part.

Table 3.6.4. Environment indicators of selected irrigation system.

Indicators	Season	Klambu Kiri	Glapan	Kalibawang			**Krogowanan**
				Kalibawang	Pengasih	Pekik Jamal	
Percent of command area affected by waterlogging	Dry	None	None	None	None	None	None
	Rainy	10%-25%	10%-25%	None	10%-25%	25%-50%	None
Percent of command area affected by salinity	Dry	None	None	None	None	None	None
	Rainy	None	None	None	<5%	<5%	None
Groundwater depth	Dry	1 m – 3 m	1 m – 3 m	2 m – 6 m	2 m – 4 m	2 m – 4 m	0.5 m – 4 m
	Rainy	0.5 m – 3 m	0.5 m – 3 m	1.5 m – 5 m	2 m – 4 m	1 m – 4 m	0.5 m – 4 m
Chemical pollution		None	None	None	None	None	10%-25%

In Klambu Kiri and Glapan, there is no problem of salinity. Waterlogging is found in a few parts of the systems. Some farmers also use the *surjan* system, but the intensity is lower than that of the Pekik Jamal and Pengasih schemes.

Basically, groundwater in the selected systems comes from shallow aquifer or unconfined aquifer. The depth varies from place to place as shown in the table 6.4. From the rainy season to the dry season, the change in groundwater depth can be considered negligible. Groundwater is utilized for agriculture in Pekik Jamal as well as in the tail of Pengasih and Glapan. In Kalibawang and Klambu Kiri, no groundwater is used. Groundwater is drawn for domestic use. In the Krogowanan system, no wells are needed to abstract groundwater because springs already provide abundant water. Also surface water is available from the Pabelan river.

Infrastructural Indicators

Infrastructure directly affects the distribution and allocation of water in an irrigation system. Infrastructural indicators show density of infrastructure in a system. Additional indicators on condition and function of infrastructure are added. The infrastructural indicators of selected irrigation systems are presented in table 3.6.5.

Table 3.6.5. Infrastructural indicators of selected irrigation systems.

Indicators	Klambu Kiri	Glapan		Kalibawang			Krogowanan
		Glapan Barat	Glapan Timur	Kalibawang	Pengasih	Pekik Jamal	
No. of infrastructure (primary and secondary level)	1298	123	348	429	205	171	148
No. of control structures per 1,000 ha	11.33	2.08	6.49	83.00	47.71	35.18	51.66
Proportion of infrastructure in very good and good condition	na	na	na	97%	98%	84%	89%
Proportion of infrastructure whose functionality in very good and good	na	a	na	100%	98%	96%	89%

Na = Data not available.

Among the selected systems, Klambu Kiri has the densest infrastructure as well as control structures. This allows a better performance of water supply, especially in relation to head-tail equity. The Kalibawang scheme has the densest infrastructural and control structures in the system. In addition, its infrastructural condition and function are generally better than those of other scheme. The Kalibawang scheme is located at the head of the Kalibawang system and it affects other schemes in the system. It has more control structures to regulate discharges to other schemes and within the scheme.

Overall Performance of the Selected Systems

The impact of irrigation system performance on poverty is indirect. Considering irrigation as a nested system, irrigation provides water as an input to agriculture, which then produces output in the form of crop production, generating incomes for farm households.

Klambu Kiri is characterized by inadequacy of water, and low cropping intensity. Although Klambu Kiri is supplied by the Kedung Ombo reservoir, its water supply fluctuates widely. This may be because of the high sedimentation along its canal. Due to uncertain water supplies and the soil condition, choice of crops is limited. Rice is a dominant crop in RS and DS 1 while mungbean is dominant in DS 2. Soybean, onion, and chili are cultivated in a few drainage areas.

IMT has not been implemented in the Klambu Kiri system. Therefore, the government in one respect is still responsible for the management of the main network. Farmers are only responsible for the management of their tertiary blocks. However, they have limited understanding of how a system as a whole works. Farmers at the head reach take water more than the planned without considering the needs of downstream farmers. Some of them divert water directly from the primary canal by using pumps. Consequently, inequity occurs between head and tail areas as well as between farmers who have and have no access to pumping technology.

In the Glapan system, water is relatively inadequate and there is a problem of sedimentation. The cropping pattern is limited to rice in the rainy season and mungbean in the dry season. Mungbean is the most tolerant crop to the soil and water conditions in the system. In this system, the management consists of three levels, i.e., the central government at primary level, regency government at secondary level, and WUA at tertiary level. This contributes to inequity in water distribution so that the tail area receives less water. However, productivity of rice is higher at the tail end.

Krogowanan is blessed with abundant water availability. Also, the system has much better markets for agricultural products. Therefore, farmers diversify their crops based on market demand. Due to abundant water availability, farmers pay less attention to the O&M of the system although the system has been transferred from the government to farmers. The overall efficiency is low and routine maintenance is absent. However, farmers are generally willing to contribute to the system rehabilitation whenever necessary.

IMT has also been implemented in the Kalibawang system. WUA manages the system properly and water is adequate in the system. Crop diversification is also practiced in Pengasih and Pekik Jamal schemes as well as in some parts of the Papah scheme in order to reduce the uncertainty due to crop failure. Supported by good infrastructural condition and good institutions, productivity in the system is fairly high.

Impact of Irrigation on Poverty

Water is an important factor in agricultural production but it is not the only one. Agricultural production is influenced by many factors. Therefore, the impact of irrigation performance on production depends on the interaction among water and other factors.

Discussions on productivity indicators suggest that, in the case of rice, higher water availability does not always lead to higher production in a particular system. Because of very varied planting patterns, it is difficult to compare productivity across systems in terms of their weight. Table 3.6.6 provides the values of water availability in term of Relative Irrigation Supply (RIS) and Relative Water Supply (RWS), total food crop value, and income per capita for the selected systems.

Table 3.6.6. Water availability, food crop production and income per capita.

System/ scheme	RIS	RWS	Value of food crop production (Rp/ha/year)	Income per capita (Rp/capita/year)
Klambu Kiri	0.7163	0.4745	9,094,851	2,317,952
Glapan	0.9216	0.4375	6,570,589	2,201,842
Krogowanan	1.6250	1.2660	9,034,063	1,757,772
Kalibawang	1.8368	1.5023	7,705,552	2,353,463
Pengasih	1.7218	1.0717	11,897,397	4,632,132
Pekik Jamal	1.8230	1.3674	11,387,531	1,570,553

Water availability is one of the factors affecting agriculture production. Table 6.6 shows that the Klambu Kiri and Glapan systems have less water availability and produce less value of crops in comparison with other systems. However, in the system with adequate water, other factors become the driving force. One of them is the soil condition. The Kalibawang scheme and the Krogowanan system have such similar physical conditions as hilly topography and abundant water availability. Rice productivity of the Kalibawang system is higher than that of the Krogowanan system. On the other hand, the value of food crop production in the Kalibawang system is lower than that of the Krogowanan system. The soil condition in the two systems is considered as the influencing factors. The soil of the Krogowanan system was formed from young volcanic materials, which is porous and rich of minerals needed by crops. On the other hand, soil in the Kalibawang scheme was formed from old volcanic materials, which is less porous and has a poor mineral content. As a result, the Kalibawang scheme is more suitable for rice because its less porosity can conserve more water in the pounding system of irrigation of the rice field. In the Krogowanan system, the mineral content and good internal drainage make its soil suitable for vegetables and upland crops so the cropping pattern is more diverse. This, in turn, produces more value of food crops. In addition, better market prospects give more support to the agricultural production of the Krogowanan system.

In a system with similar soil and water conditions, other factors may determine the value of food crop production. Within the Kalibawang system, where water availability among schemes is similar, crop diversification becomes the influencing factors. The Kalibawang scheme produces less value of food crops while the Pengasih and Pekik Jamal schemes have more diverse cropping patterns and grow such high-value crops as chili. Although the Pekik Jamal scheme has the lowest rice productivity, it produces more value of food crops during a year. To overcome problems of flood as the scheme is located at the tail end of the Kalibawang system as well as to conserve water, farmers in the Pekik Jamal scheme and some parts of Pengasih scheme apply the *surjan system*. It consists of the higher part of the land called the *tabukan* and the lower part called the *ledokan*. In the *ledokan*, rice is grown during the rainy season while in the *tabukan* various upland crops and vegetables are grown in strip cropping and transplanted at different planting dates. This ensures continuity of farmers' income and reduces the risk due to the failure of a certain crop.

Food crop production is one of the sources of family income. However, as shown in table 3.6.6, the relationship between the value of food crop and income per capita is not always straightforward. In the Kalibawang system, values of the food crop in Pengasih and Pekik Jamal schemes are higher than those of the Kalibawang scheme. Despite this, the Pekik Jamal scheme has the lowest income per capita while the Pengasih scheme has the highest. Although in the Klambu Kiri system, income from food crops is higher than that of the Glapan system, income per capita in the two systems is similar. This is because total income is composed of income from non-crop farm sources, and nonfarm sources.

In the Pekik Jamal scheme where the food crop value is high, farmers have to spend more time to take care of their high-value crops so they have less time to take up nonfarm jobs. On the other hand, farmers in the Kalibawang scheme grow more rice, which need less attention. Therefore, they have more time available to go for nonfarm jobs. Besides the nonfarm job opportunity, there are such factors to consider as income earned from livestock and animal husbandry and the market system, which influence the price of agricultural products and other source of income.

Constrains and Opportunities

Following are some of the major constraints to improving systems performance:
Because irrigation is one of the factors that influences productivity and farmers' welfare, improvement of irrigation system performance is one way to achieve it. Currently, the process to enhance the irrigation system performance deals with such constraint as:

The human resources problem
The local government has limited ability to identify the local conditions and to implement its decision. Long-time experiences as the national program executor restricted the development of an initiative for local government officials. Likewise farmers who previously acted as the net-recipient of the government program became apathetic in managing their irrigation system. In addition, farmers, who used to manage tertiary blocks, have a limited knowledge about the whole irrigation system. Consequently, they find difficulties in managing secondary or higher levels.

Sociocultural diversity
The sociocultural diversity in each region has not been fully recognized. This is important to improve performance of the irrigation system because the best O&M of the irrigation system is the one that is compatible with the local conditions.

Limited available data and information
Nowadays, appropriate database and information related to water resources is unavailable. Additionally, the condition of measuring devices is poor, and data collection and analysis are not standardized. Therefore, it is difficult to continuously monitor the irrigation system performance and provide accurate information for the O&M planning.

Underperforming of management functions

The management functions are under-performed as indicated by weak coordination among related parties in water-resources development and management. Since the performance of the irrigation system depends on interactions among many factors and actors, unqualified management functions result in poor performance of the irrigation system.

Inappropriate existing irrigation system design to support crop diversification

The research result suggests that crop diversification provides more income to farmers. However, the existing irrigation systems were designed to support rice self-sufficiency.

While there are several constraints, there are also opportunities for improving system performance. These include:

Local autonomy

Local autonomy as stated in Law No. 22/1999 gives flexibility to accommodate local potential, which varies from place to place. By the local autonomy, the local government may be able to develop a management system suitable to its region.

Irrigation management policy reform

The irrigation management policy reform, stated in GR No. 77/2001, has an objective to improve farmers' welfare. The policy provides a legal basis for better irrigation management to improve irrigation system performance and farmers' welfare.

Natural condition

The natural condition in Indonesia is favorable for agriculture. Located along the equatorial line with sunshine throughout the year, abundant rainfall and volcanic soil there are many opportunities to improve irrigation system performance.

Indigenous knowledge and technology

Agriculture has been a tradition since centuries in Indonesia. Many indigenous techniques related to cultivation have been developed. For example, *pranata mangsa* is a Javanese method to determine time for cultivation based on the position of the sun and climate, and it is proven accurate in Java and Bali. It is necessary to improve this type of knowledge to develop the most appropriate action to improve irrigation system performance.

Considering the constraints and opportunities, some strategies can be suggested to improve irrigation system performance so that it is advantageous to poor farmers:

Irrigation network design and management to support crop diversification

The existing irrigation systems were designed to support rice self-sufficiency. In addition, their management system was developed to support a uniform planting pattern with rice as the dominant crop. Studies on productivity performance show that crop diversification generates more incomes for farmers. Therefore, the design and management of the irrigation system should be modified to support crop diversification and eventually provide more benefit to farmers. This requires comprehensive research to discover the most appropriate irrigation system design and management.

Participatory O&M manual

Before the implementation of the irrigation management policy reform, the water- management procedure applied in Indonesia is the O&M-form system. After IMT has been implemented, O&M is conducted based on local conditions of each system including the capability of the WUA. Therefore, each system needs an O&M manual that is developed by WUA members in a participatory way. This participatory O&M manual is expected to produce better performance than the previous nationally uniform O&M system.

Training need assessment for local government officials

Capacity building for local government officials is important because, with policy reforms, they have different roles and face different challenges. Training need assessment is important to develop the most suitable program of capacity building.

Training need assessment for farmers

Similarly, farmers in WUAs, who become the managers of their own irrigation systems, need capacity building as well. The training needs assessment should cover all aspects related to irrigation, agriculture, organization and management.

Asset management plan

The condition of the irrigation system network affects water delivery performance. The asset management plan provides farmers and the government with a tool of maintenance of irrigation structures and determines contributions in irrigation system maintenance.

Information system

The development of agribusiness in the irrigation system to improve farmers' welfare requires an information system. The information system includes information about climate, real-time water availability, markets and so on.

3.7. ANALYSIS OF IRRIGATION MANAGEMENT INSTITUTIONS: IMPLICATIONS FOR THE POOR

Organization of Irrigation Management

The succession of *Orba* (New Order) has resulted in the change of status in irrigation management organization. Normatively, such a status change is inherent with the differences between GR (government regulation) or PP (*peraturan pemerintah*) No. 23/ 1982 and GR No. 77/ 2001. The differences between these two government regulations are basically the reflection of different paradigms of *Orba* and the new regime. The *Orba* regime is characterized by centralization and tends to put the government interest as its main priority, while the new regime is characterized by decentralization and puts people's interest as its main priority. Therefore, there is a change in the organization of irrigation management from the one which is dominated by the government (monocentricity) to the one that is oriented to the people's interest (polycentricity).

At system level, irrigation was originally managed by peasants, called "farmer-managed irrigation system." This kind of organization of irrigation management has its formal status since it is attached to the structure of rural government. During the *Orba* era, the government dominated the organization of irrigation management by implementing joint management in which the government managed the primary and secondary levels while the peasants (i.e., WUA) managed water at the tertiary level.

Presently, in line with the new paradigm of the recent government, the management of irrigation is being gradually transferred to WUAs. However, there are several problems emerging during the transition period, including those related institutional arrangements at the system level. One of the problems relates to the exercise of authority by WUAs as stipulated in GR 77/2001. Field research shows that some WUAs still operate under power structures of village officials/government. Comparison of functions of WUAs in Kulonprogo with those in Klambu Kiri and Glapan illustrates the case.

In the Kulonprogo region, there is a single WUA in a tertiary block. It is located in one village, but it is not under the domain of village government. The WUA has its own domain based on hydrological territory. Irrigation management is done based on WUA authority and statute/regulation under the agreement of members at the meeting. In Klambu Kiri and Glapan, the organization of WUA is more complex. A WUA consists of several subunits of WUA located in different villages. The establishment of a WUA was based on *SK* (Letter of Decision) of Regent of the Orba era. This background has led the village officials to interfere with the irrigation management. Irrigation management is conducted based on the coordination among subunits of WUA under the intervention of village officials. In this situation, a WUA cannot exercise its authority as stipulated by GR No. 77/2001.

Establishment Process

According to GR No. 77/2001, a WUA is established on the principle of one system, one management, based on local conditions. Normatively, a WUA has its own authority, and it is autonomous and self-supporting. A WUA represents farmers and provides a forum for them. The procedures and related rules of WUA establishment are regulated by *Kepmendagri* (Decision of Minister of Home Affairs) No. 50/2001. In principle, a WUA is established from, by, and for farmers democratically, for either the staffs or members who come from among farmers/water users.

There are some differences in procedures for establishment of a WUA (*P3A*) and a WUAF (*GP3A*). The procedure for a WUA establishment can be described as follows:

1. Farmers /water users organize themselves to come up with the agreement to form a WUA and WUA's staffing, and then draft the design of statute/regulations (*AD/ART*).
2. WUA establishment, WUA staffing, WUA statute/regulations are decided in the member meeting and reported by staff/head of WUA to Regent/Mayor.
3. WUA registers statute/regulations to the Courts or notary to obtain the status as a corporate body.
4. In case the establishment of WUA is not democratic, the regional government facilitates the farmers to develop an agreement in line with their request in the context of improving the institutional establishment of the WUA.
5. In case the institutional establishment is not agreed upon, the regional government facilitates the farmers to achieve a second agreement in line with the request in the context of improving the institutional establishment of the WUA.

The establishment of a WUA Federation can be described as follows:

1. Some WUAs located in an irrigation area or at WUAF/primary level organize themselves to come up with an agreement of WUAF establishment, staffing of WUAF, and then draft the design of statute/regulations of WUAF.
2. The establishment of a WUAF, staffing of WUAF, and statute/regulations are decided in member meeting and reported by staff/head of WUAF to Regent/ Mayor.
3. Regarding the IMT, the WUAF has to register statutes/regulations of WUAF to the Courts or notary to get the status as a corporate body.

According to *Kepmen Kimpraswil* (Decision of Minister of Settlement and Infrastructure) No. 529/KPTS/M/2001 on Directive for IMT to WUA can be described as follows:

1. The establishment of WUAs/WUAF is an effort by farmers, democratically, as an institutional instrument of a WUA/some WUAs that utilize irrigation facilities, in agreement to cooperate with management at one irrigation area or at the secondary or primary level.
2. Activities at secondary level (WUAs): WUAs are established democratically. After the establishment of WUAs at each tertiary block of an irrigation system, the established WUAs evaluate problems facing each WUA which are discussed at the secondary network of management. Due to the common interest of WUAs at head, middle, and tail

areas, WUAs that will manage the network and solve problems of irrigation management at secondary level need to be established.

3. Activities at the irrigation system level (WUAF): WUAFs are established democratically. After the establishment of WUAF at each secondary level or each part of an irrigation system, WUAF evaluates problems at each WUA, which are discussed at the management level. In medium irrigation systems with a few WUAs, those WUAs establish a WUAF. Especially for small-scale irrigation systems that consist of one WUA, that WUA automatically functions as WUAF.

Based on the WUA statute/regulations, a WUA is established with no time limitation and which has validity after getting agreement from the head of village, head of subdistrict, and legalized by the Regent/Mayor. *Field research shows the fact that there are many WUAs (P3A) that have been established improperly (not in line with the regulation). They have been established through a top-down approach, as what happened in Krogowanan and Papah, in which the WUA was established just to meet the requirement of socialization activities dealing with the event of IMT.*

Authority

Compared to GR No. 23/1982, GR No. 77/2001 provides more authority to farmers/ WUAs to manage their irrigation system. GR No. 23/1982 provides authority of irrigation management limited to the tertiary level of the irrigation system, while the primary and secondary levels are under the authority of the government. Article 9, Clause 1 of GR No. 77/2001 stipulates that the regional government should transfer the authority of irrigation management to the WUA. It means, as stated in article 9 clause 2 of GR No. 77/2001, that the primary and secondary levels of irrigation network are under WUA authority.

Based on the principle of one system, one management of irrigation, the IMT covers O&M, security, rehabilitation and upgrading for an irrigation system. Regarding the development of the network, the WUA has authority in developing a tertiary irrigation network and also developing an irrigation network for expansion of the irrigated area in its operational territory. In relation to O&M, the WUA has authority on O&M in its operational territory.

According to article 13 of *Kepmendagri* (Decision of Minister of Home Affairs) No. 50/2001, the authority of an FO from the tertiary up to the WUAF covers the following:

- To set up planning and consensus on irrigation management in line with services as needed by WUA, WUAs, and WUAF at operational area under their responsibility.
- To perform the irrigation management at operational area under their responsibility, including the integrated management of groundwater and surface water.
- To accomplish monitoring and evaluation of activities of irrigation management in operational territory under their responsibility.
- To manage funds for irrigation management for sustainability of irrigation systems.

After the launching of Irrigation Management Policy Reform in 1999, the government gradually transferred the management of some irrigation systems to WUAs. In its realization, the transfer is dependent upon the readiness of a WUA to manage irrigation in line with the new system of irrigation management. This results in differences in management in the selected systems. Among six schemes in the Kalibawang system, Papah and Pengasih scheme were transferred in 1999 while the others were transferred in 2002. In Papah and Pengasih schemes, the WUAF manages the secondary level starting from the main diversion structure while government officials manage the main intake. In the Kalibawang scheme, two WUAFs shared the management of the Kalibawang primary canal. In Pekik Jamal, the WUAF manages the system from the main intake to the primary- and secondary-canal levels. The Krogowanan system was transferred in 1999. Currently, the WUAF of the Krogowanan system manages the system up to the primary canal. However, government officials are still responsible for managing water diversion from the main intake in the Pabelan river.

O&M Procedure

Prior to the launching of policy reform in the country, GR No. 23/1982 was the legal basis to conduct O&M of an irrigation system. The O&M procedure was applied at the farmer level to the province level. The O&M procedure was standardized into the O&M-form system, which consists of 16 O-form for operational procedure and 18 P-form for the maintenance procedure. Basically, the operational procedure consists of three main activities, namely, determination of planting pattern, water distribution and monitoring. The maintenance procedure consists of activities of physical maintenance, recordkeeping, planning as well as implementation and monitoring.

Operation Procedure

The O-form procedure, as shown in figure 3.7.1, consists of three stages, i.e., determination of global crop planting area, determination of irrigation service discharge, and monitoring and data gathering. The O-form procedure starts with the determination of the cropping pattern by WUA (O-01 form). The input from WUA is then submitted to the water master (O-02 form) and then to the higher-level officers (O-03 form and O-04 form) to determine a global planting pattern. The global planting pattern becomes a basic tool to determine cropping pattern allowed in the area. In the implementation procedure, the actual planting area of each crop (O-04 and O-05 forms) is used to calculate the irrigation water requirement. The K-factor or ratio between actual river discharge and irrigation water requirement shows whether river discharge (O-06 form) is adequate to fulfill the irrigation requirement. In case K-factor equals unity or more, water is allocated to tertiary blocks according to the irrigation requirement. If K-factor is less than 1, water is allocated as big as the K-proportion to the irrigation requirement. The determination of the K-factor requires river discharge data (O-08). Monitoring activities consist of collection of rainfall data (O-11 and O-12), discharge data (O-10 and O-13) and actual cropping area (O-15 and O-16).

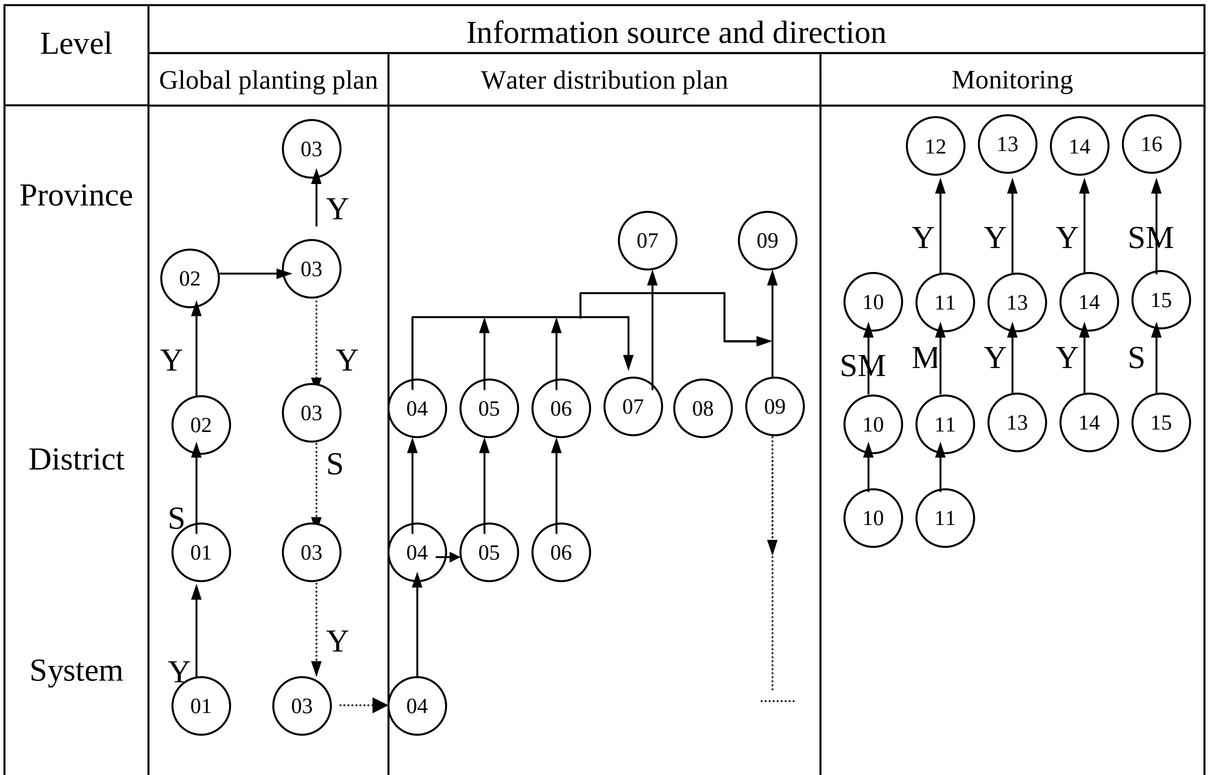
Maintenance Procedure

The maintenance procedure using the P-form, as shown in figure 3.7.2, consists of incidental maintenance, routine maintenance and heavy maintenance. Incidental maintenance takes place when a structure in irrigation systems is destroyed due to natural disaster or human error, which may be dangerous. The reports on incidental maintenance (O3-P form) go directly from system level to provincial level as an emergency report. The deteriorated structure, which is not considered to be repaired in an emergency, is reported from the water master (01-P form) to higher level (02-P form).

The routine maintenance, with such activities as lubrication of gates and canal cleaning, follows the procedure of planning and implementation by irrigation section at district level to provincial level (04-P form). The routine maintenance is implemented by the labor of the irrigation section at the district level.

The heavy maintenance consists of two types of works, namely self-managed and contracted work. Officials of the irrigation section at the district level conduct the self-managed works. The plan (07-P form) is formulated in the irrigation section and reported to the provincial level. The implementation (11-P form) is reported from the irrigation section to provincial level (12-P form). A private contractor conducts the contracted works planned in the irrigation section at district level (08-P form) and reports from the irrigation section to the provincial level (10-P form).

Figure 3.7.1. Operation



Form		Form		Form	
No	Explanation	No	Explanation	No	Explanation
01	Planting plan in tertiary level	04	Tertiary planting area	10	Flood river discharge
		05	Permitted planting area	11	Rainfall data
02	Planting plan in water master level	06	Measured discherge	12	Yearly rainfall data
03	Global planting plan	07	Irrigation water requirement	13	Yearly river discharge data
		08	River (source) discharge	14	Scheme crop data
		09	K-factor determination	15	Seasonal planting area
				16	Yearly planting area

Notes:

: info direction
: feedback direction
Y : yearly
S : seasonally

SM : semi monthly

M : monthly

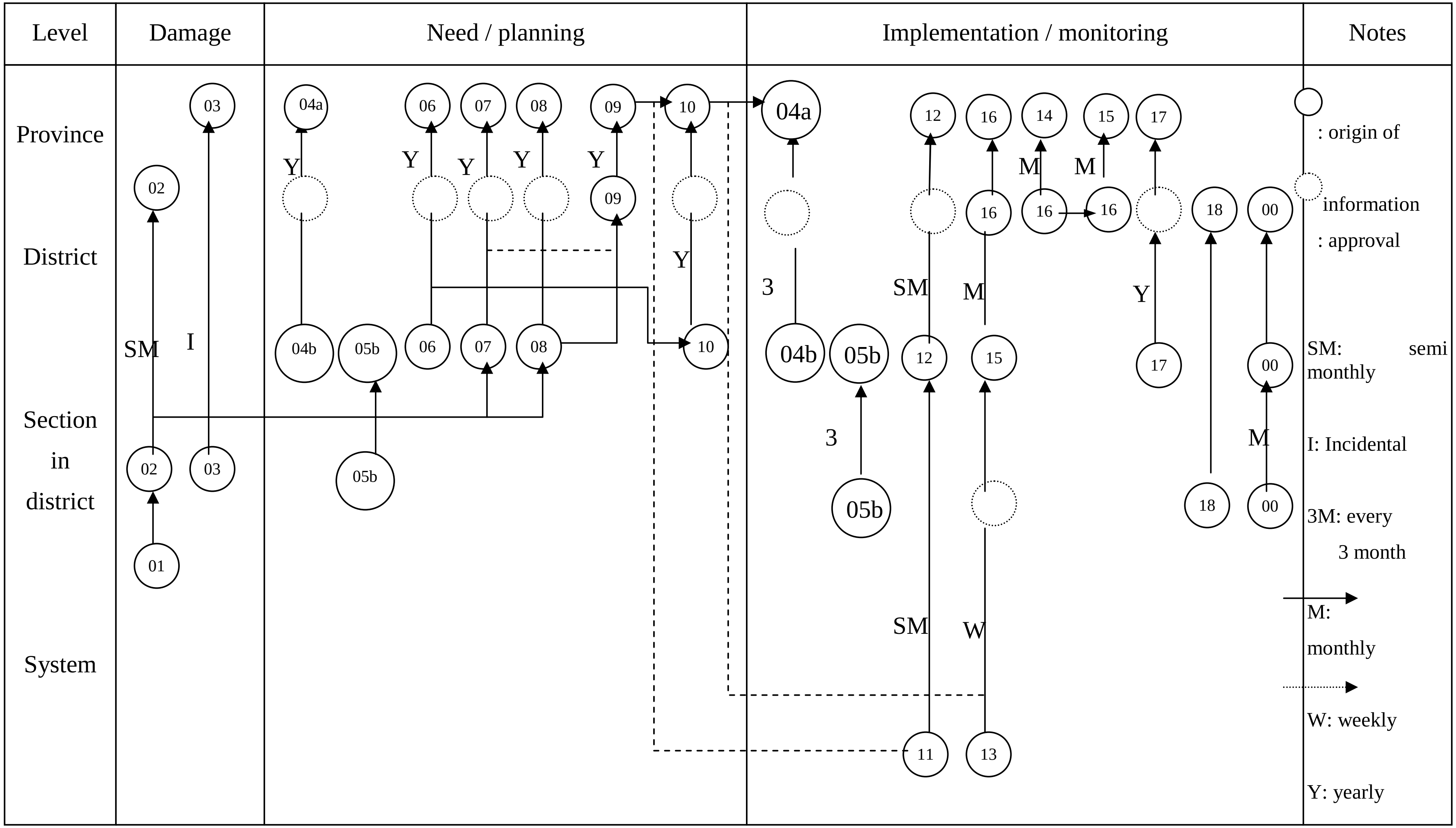

Level
Damage
Need / planning
Implementation / monitoring
Notes
Province
District
Section
in
district
System
01
02
03
SM
I
04a
04b
05b
06
07
08
09
10
Y
3
SM
M
W
11
12
13
14
15
16
17
18
00
: origin of
information
: approval
SM: semi monthly
I: Incidental
3M: every
3 month
M:
monthly
W: weekly
Y: yearly

Figure 3.7.2. Maintenance procedure.

Form No	Explanation	Form No	Explanation
00 – P	Report of maintenance	08 – P	Priority scale of temporary contracted maintenance
01 – P	Report of scheme damage and irrigation facility report	09 – P	The self-managed program
		10 – P	The temporary contracted program
02 – P	Report of scheme damage and irrigation facility report	11 – P	Implementation of temporary self-managed works
03 – P	Report of natural disaster damage/emergency	12 – P	Implementing of temporary self-managed working
04 – P	List of paint and lubricant of control structure	13 – P	Weekly contracted progress report
	c) Planning	14 – P	Monthly monitoring: inspection of self-managed material
	d) Implementation	15 – P	The use of self-managed material
05 – P	List of payment and material stock	16 – P	Monthly report: realization of temporary contracted work
06 – P	Report of measuring and scheme maintenance and irrigation facility	17 – P	Monthly report: realization of maintenance
	Priority scale of self-managed maintenance	18 – P	Monthly monitoring: use of paint and lubricant of big control structure

In case of water allocation procedures, the two systems still use the O&M-form system. From the management point of view, the O&M-form system is an accurate and efficient system. However, it requires a) availability of hydraulically accurate measuring devices and b) supporting data and information on water availability.

In O-form procedures, farmers only participate in the determination of the cropping pattern by providing information on their crops and planting area for the next planting year. On the contrary, government officials conduct other activities including determination of the amount of water delivered to tertiary offtakes. As the local government is responsible for water allocation at primary and secondary levels and farmers are responsible for water distribution at the tertiary level only, the system does not ensure transparency and accountability in implementation.

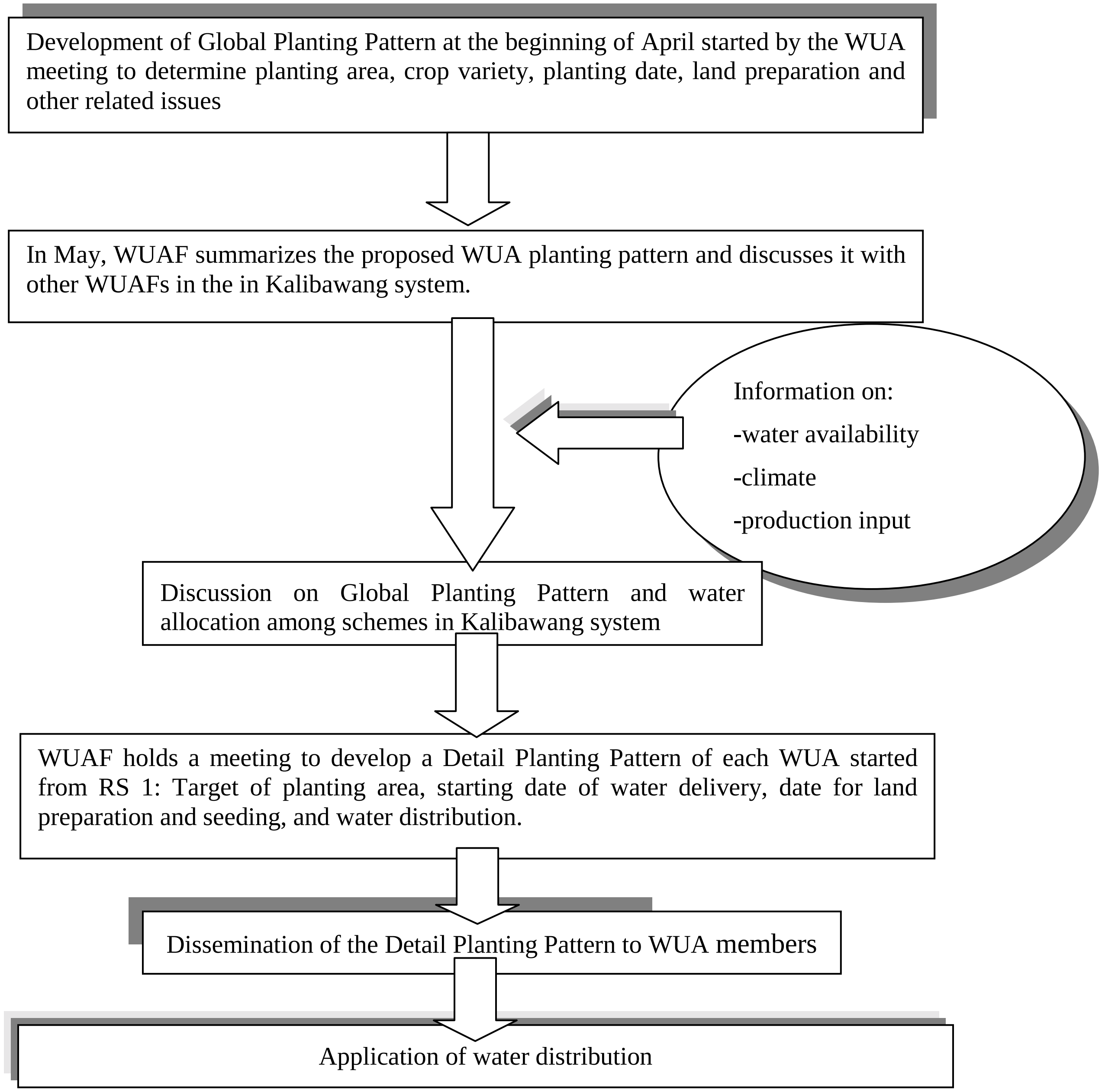
In addition, the O&M-form system is incapable of responding to economic changes. The system was developed with the assumption of a uniform planting pattern to support the rice self-sufficiency program. As a consequence, the system became rigid and cannot support a flexible planting pattern driven by market, water availability and other related factors. Farmers need a participatory O&M, which is flexible and more suitable for local conditions.

In case of an O&M system, the Klambu Kiri and Glapan still use an O&M-form system. Because of the difficulty in fulfilling the requirement of the O&M-form system, implementation of the operational system in Klambu Kiri and Glapan works inappropriately, especially in the second and third planting seasons when water availability is very limited. Besides the limited water availability, inappropriateness also occurs because of other factors. First, the provincial government, the district government and farmers show no coordination in ensuring transparency and accountability in irrigation water management. Second, the rate of sedimentation is high, reducing canal capacity. Third, the process of rearrangement of the authority structure at the district level works unfavorably. In accordance with the policy on Regional Autonomy, the district government has authority to set up its government district offices. In Grobogan, water management has become the responsibility of the District Office of the water resource, structure and sanitary, while in Demak it became the responsibility of the District Office of Public Works. The new government officials do not have the required experience and educational background in irrigation management.

The situation is different in the Kalibawang and Krogowanan systems where IMT has been implemented. The Kalibawang and Krogowanan system do not use the O&M-form system anymore. The government official allocates water among schemes and secondary canals, WUAF distributes water among tertiary blocks and WUA distributes water within tertiary blocks. The method of water allocation is discussed at the system level or secondary level before the first planting season.

In Krogowanan, water is abundant so that water allocation and distribution are not problems for the WUAF. They pay less attention to the procedures and provide no written O&M procedure. In the Kalibawang system, the WUA with assistance from the Government of Kulonprogo and the Gadjah Mada University developed a written participatory O&M procedure for every scheme. The procedure consists of planting the pattern plan, and water distribution and maintenance procedures. The planting pattern is decided at the beginning of every planting season. An example of the participatory O&M procedure is shown in figure 3.7.3

Figure 3.7.3. Participatory O&M procedure of the Kalibawang scheme.



Finally, the maintenance of the Kalibawang scheme is scheduled through discussions among WUAs from all schemes in the Kalibawang system. Maintenance of other schemes is scheduled in accordance with the maintenance schedule of the Kalibawang scheme. Generally, farmers emphasize on equity on the period of discharge rather than on equity on the volume of water. Therefore, farmers let all tertiary offtake gates open and allow water to flow to all tertiary blocks. If a tertiary block receives adequate water, its gate should be closed to allow more water flowing to other blocks.

Relations with Other Organizations

According to *Kepmendagri* (Decision of the Minister of Home Affairs) No. 50/2001, the character of the work relation among WUA, WUAs and WUAF is cooperative, coordinative and consultative and, furthermore, regulated in each statute/regulations according to its operational territory. The WUA, WUAs and WUAF are able to carry out mutual work with regional government agency, institution/body or other parties for equity and mutual benefit.

According to GR No. 77/2001, the WUA can have relations and links with other organizations such as cooperatives, small enterprises, etc. According to *Kepmen Kimpraswil* 529/2001, the WUA, WUAs and WUAF have rights to invite other parties to cooperate with, including their province or regency area.

Performance

Compared to the performance of the new system of irrigation management at meso level, the performance at system level provides more information about how far the new system of irrigation management has worked. It can be stated that the performance at the system level is representing the actual performance of the new system of irrigation management. This is because, operationally, the new system of irrigation management is handled by, and under the responsibility of, the WUA. However, WUAs still face many problems and handicaps.

Based on the primary data provided by field-research as shown in table 6.1, some aspects of the performance of WUA can be described as follows:

- Most of the respondents in four selected irrigation systems stated that the establishment of WUA was by agreement in the meeting (*musyawarah*). It seems that this information will bring us to the conclusion that the existence of WUA is agreed to by farmers/water users. In other words, it seems that the existence of WUA has been well socialized among the farmers/water users.

- On the other side, the data have also shown the majority of respondents to have stated the idea of the establishment of a WUA as coming up from village officials. In interpreting these information/data, some characteristics of rural people/farmers should be taken into account in the analysis, e.g. a) in general, village officials in Java tend to be intimated with dominant and deterministic characters, b) rural people/farmers on the other side tend to be passive (the silent mass). The passiveness of the farmers is reflected from the fact that a) the majority of members of WUA do not know or do not have any knowledge about statute/regulations (AD/ART) of the WUA, besides the fact that they were not involved in the process of its establishment, b) there are some members (in significant numbers) who do not know or do not have any knowledge about the fact that the WUA is having regulations to deal with. From these observations, it can be concluded that although the establishment of the WUA was the product of agreement, village officials were actively playing the role during the process of its establishment. It means that the establishment of the WUA is not well socialized and institutionalized as yet.

- Available information suggests that a) many respondents knew that the WUA was registered formally as an organization in their territory, b) many respondents also knew that the statute/regulations of the WUA were ratified by the Regent of the region. It means that the farmers organized in the WUA are aware of the fact that the WUA is a part of the governmental structure of power to which the people/farmers have to submit. It means that from the other side of viewing the institutional process the WUA is not coming from the people/farmers/water users.

- The institutional process of WUA through socialization among its members has also not worked yet. This conclusion is based on the data which show that a) meeting among members of the WUA is rarely held, mostly just once in a season, b) the presence of members in the meeting, either at the block level, plot level or WUA level is, in general, rare.

- The dominant groups of farmers that take care of ISF are the sharecroppers as compared to the owner farmers. It means that a) the poor get a heavier burden than the richer farmers (with the assumption that the owner farmer is richer than the sharecropper), b) the regular amount of ISF tends to be unstable compared to the situation in which the ISF is under the responsibility of the owner farmers.

- During the dry season, the farmers in all irrigation systems are under study but in the tail part of the Glapan experience there are no major problem of irrigation. It means that a) the system of irrigation management of those areas, including water distribution, has been running well, or b) all selected irrigation systems, in essence, have no problem with irrigation but in Glapan. If the second conclusion holds, it means that the existence of the WUA is not important for farmers' livelihoods.

- Available information also suggests that *KPL* (official who is doing guidance and counseling in irrigation matters) plays an active role. However, how far is the effectiveness of what had been done by the *KPL* in increasing the performance of the WUA is still in question.

Table 3.7.1. Respondent opinion on the performance of the organization of irrigation. management.

Aspect	Kalibawang	Krogowanan	Glapan	Klambu Kiri
Percentage of respondents who stated that WUA was established by agreement	97.88	81.96	88.46	96.66
Percentage of respondents who stated that WUA is initiated by village officials	75.03	79.83	39.76	50.63
Percentage of respondents who were not involved in the process of establishment	65.18	74.62	49.33	50.89
Percentage of respondents who did not know that WUA is having a regulation to deal with	15.78	30.00	44.42	44.30
Percentage of respondents who knew that WUA is registered as an organization	91.19	86.87	39.58	56.33
Percentage of respondents who knows that WUA statute/ regulations was ratified by regent	73.89	69.99	42.81	26.48
Percentage of respondents who stated that WUA meeting is held once a season	16.14	19.81	49.34	63.17
Percentage of respondents who rarely attended:				
- block meeting	21.18	13.19	56.20	77.06
- tertiary meeting	15.61	24.74	58.79	84.45
- WUAs meeting	63.58	62.22	79.18	90.22
Percentage of share croppers who paid for ISF	64.84	59.30	92.01	87.21
Percentage of respondents who stated that KPL is active	67.58	50.65	57.62	59.27

Source: Primary data, 2002.

The results of observations through the PRA method and field visits have indicated some problems in the performance of the new system of irrigation management (table 3.7.1.). Some of the identified problems are given below.

- The four selected irrigation systems showed the following tendencies: a) there are clashes of interests among various departments dealing with irrigation (Agricultural Department, Settlement Department and Regional Department); b) irrigation management at the system level is potentially centralistic; c) politicizing and bureaucratizing on farmers'/social organizations; d) the mechanism of giving authority to farmers as in law No. 22/1999 is not enclosed. Instead, the authority is biased towards village officials (village head and BPD-board of village representative).

- Some WUA had not been established through a process as ought to be. Instead, it was still established through a top-down approach. As an example, in the Krogowanan and Papah, the WUA was established just to enable socialization activities of IMT.

- In the Klambu Kiri and Glapan systems, irrigation management transfer has not been implemented as yet. Therefore, the two systems still keep the joint management where WUA manages tertiary levels and the government manages the rest of it. Preparation for the transfer is still in the process of establishment of WUAF, which is prepared to manage secondary and primary levels. For better understanding, it should be noted that during the period of recent government, as stipulated in GR No. 25/2000, there are three levels of irrigation management, i.e. the province, regency and system level. In the context of regional autonomy the province and the regency are often seen as one unit, i.e., the regional government. In fact, those two levels of regional governments are having their own authorities in the irrigation sector.

- The results of the Participatory Approach Study in Klambu Kiri and Glapan have uncovered the fact that the process of the WUA establishment in those irrigation systems was done by village officials in cooperation with the Department of Irrigation without prior socialization among its members.

Table 3.7.2. The profile of WUA in four irrigation areas under study.

Factors	System			
	Klambu Kiri	Glapan	Kalibawang	Krogowanan
WUA legality	Regent's decision letter during Orba	Regent's decision letter during Orba	Regent's decision letter based on GR 77/2001	-Regent's decision letter based on GR 77/2001
IMT implementation	No	No	Yes	Yes
Organization rules	Not working	Not working	Working	Working
Active staffs	1-2 personnel	1-2 personnel	3-5 personnel	3-5 personnel
Work plan	Unwritten	Unwritten	Unwritten	Written
Program enforcement	Not performed yet	Not performed yet	Well enough performed	Well performed
Funding sources: Member gathering	-None	-None	Exists	Exist
ISF	Not running well	Not running well	Not running well	Not running well
performance	Still under the intervention of village officials	Still under the intervention of village officials	More autonomous	More autonomous
Territory	Administrative territory	Administrative territory	Hydrological territory	Hydrological territory

Source: Primary data, 2002.

As shown in table 3.7.2, the IMT has not been implemented in Klambu Kiri and Glapan systems, while in the Kalibawang and Krogowanan systems the IMT has been implemented. However, in fact, the IMT is not the main factor that split those two irrigation areas into extremely dichotomical types of irrigation management that is relevant to poverty alleviation. In relation to the poverty problem, the Krogowanan system has different characteristics compared with the Kalibawang system. In general, long before the implementation of IMT, farmers in Krogowanan had access to a good market for their agricultural products. On the whole, it is still too early to judge whether the IMT implementation will or will not have impacts in terms of increasing farmers' prosperity. Some differences across systems in relation to IMT include:

- As compared to Krogowanan and Kalibawang, Klambu Kiri and Glapan are still much under intervention of village officials.
- The program of enforcement of irrigation management in Krogowanan and Kalibawang systems has been performed well compared to those in Klambu Kiri and Glapan systems.
- The organization rules of WUA in Krogowanan and Kalibawang have been working, while this is not the case in the Klambu Kiri and Glapan systems.

The Organization of Irrigation Management at Meso Level

Status and Establishment Process

According to Law No. 22/1999 on regional autonomy, there are two levels of regional government, i.e., the province and regency/city level. Each of them has its own authority in the irrigation sector as stipulated in GR No 25/2000. Hierarchically, the province is to be the first while the regency is the second level of the regional government.

Formerly, under the *Orba* regime, the regional government had no autonomous status as in the new era. In the new era, Law No. 22/ 1999, gives a broad autonomous status to the regional government to manage almost all affairs except for religion, external affairs, politics, monetary and fiscal, defense and security and justice. However, it does not mean that the regional government with such a broader autonomous status has a dominant role than it had during the Orba era. In fact, the role of the regional government is even less dominant than it had during the Orba era.

According to the transitional decree of GR No 77/2001, the irrigation management, including its organizational aspect, which was based on GR No. 23/1982 has to be adjusted to GR No. 77/2001 during one year. In fact, this is not always the case. *In the Grobogan regency, the organizational structure of the Department of Irrigation has not changed yet. It still keeps the old structure (of the Orba era) as follows: Subdepartment section of technical planning and program, information and permission, rural irrigation, maintenance operation, rehabilitation and development.*

The province/regency level has its own procedures for the establishment of institutions. According to Regional Regulation of Central Java No. 1/ 2002, the procedures and its related steps can be described as follows:

1. The establishment of an action unit of departmental and nondepartmental government institutions, and working units that will be transferred to province, is regulated further by Regional Regulation.
2. In case this Regional Regulation is effectively prevailing, then, all regulations that are not in line with this regulation will be drawn and stated as no more valid.
3. Matters that have not been regulated yet by this Regional Regulation, as long as dealing with its implementation, will be regulated further by the Governor. This Regional Regulation can be reviewed at the latest after 2 years since its enactment.

Authority

At the regency level, there is an irrigation commission responsible for assisting the Regent/Mayor for increasing the performance of irrigation management. The irrigation commission consists of representation of government authority that is in charge of irrigation activity, representation of WUA, NGO, University and others concerned with irrigation matters. There are some authorities that are given to the government of regency, such as: offering assistance and facilitation of O&M of irrigation system under WUA management, financing the development of the main irrigation network, and offering assistance and facilitation in network rehabilitation and upgrading. Working relations with the regional government agency to improve organizational aspects, agriculture, irrigation and enterpreneurship are realized in agreement of irrigation management.

Performance

The performance of new system of irrigation management at the meso level can be seen at two levels, i.e., the province and regency. It seems not to show a remarkable contribution to the progress or development of the new system of irrigation management. One factors that is responsible for such a tendency is the decreasing authority of the regional government in irrigation management. During the *Orba* era, based on *Inpres* (Presidential Instruction) No. 2/1984, the regional government (province and regency) had monitoring functions for WUA performance. Under the authoritarian character of the *Orba* regime, the regional government still has strong grips in controlling and managing irrigation management from meso (province and regency) level down to the system level. Recently, the regional government, mainly at provincial level, has no more such a strong grip to control the system of irrigation management. In line with the principle of empowering people (c.q. farmers) as in GR No. 77/2001, the authority to manage irrigation is now in the hand of farmers represented through WUAs.

The defective performance of the new system of irrigation management at meso level has also resulted from the existence of “sectoral ego” that tends to blockade cooperation among sectors horizontally. In this context, the sectoral ego is meant as egocentrism and/or fanatism of several sectors/departments such as agriculture, public works, government (local and regional), etc.

The Organization of Irrigation Management at National Level

As described in some parts of this report, the succession of the regime from *Orba* (New Regime) is not an ordinary change. It has brought a new paradigm into existence. In the form of regulations, the new paradigm is reflected in *Inpres* (Instruction of President) No. 3/1999, GR No. 77/2001, *Kepmen Kimpraswil* (Decision of Minister of Settlement and Infrastructure of Territory) No. 529/2001 and *Kepmendagri* (Decision of Minister of Home Affairs) No. 50/2001. In the form of policy, one of the fundamental changes as a consequence of the new paradigm is the transfer of irrigation management from government-dominated type of management (monocentricity) to a type of management under farmers/water users (polycentricity).

All regulations/laws and policies for irrigation management do not promptly change the condition of former irrigation management to be one that is in line with the new paradigm. Along with its performance, many problems and constraints have to be faced at macro, meso, or system (micro) levels.

At macro level, the case can be shown through the implementation of *Inpres* No. 3/1999. This *Inpres* consisting of five policies has not been finalized as yet with its rules of implementation. The implementation rule of the last two policies (policy IV and V) has not been done yet. Another examples of such performance problems as revealed by Arif (2002)[60] are: a) not all involved sides/parties are willing to accept GR No. 77/2001 as a basis for new irrigation management; b) acceptance is mainly for coordinative and polycentric character of GR No. 77/2001; c) many among the stakeholders have only a limited understanding of GR No. 77/200. Such an understanding is a necessity for all sides/parties to be involved proportionally in the new irrigation management. Another problem related to the performance of new irrigation management at macro level is related to bureaucracy in Indonesia. In general, the existing bureaucratic system and its apparatus in Indonesia are not ready to adjust themselves to the new paradigm with their regulations/laws on irrigation management.

Irrigation Financing

Before the reformation era, irrigation financing in Indonesia was under the government's responsibility. As stipulated in GR No. 23/1982, the responsibility of the local government covered exploitation and maintenance cost of the irrigation network and supporting structure from the intake up to the 50-m long tertiary canal after the offtake. The farmers' responsibility is limited to the tertiary level. This situation leads to farmers' dependence upon the government.

Through the government policy on O&M in August 1987, farmers' participation in irrigation financing by enforcing ISF program from the General Directorate of PUOD (Common Government and Regional Autonomy) was initiated. ISF was collected by DIPENDA (Department of Regional Income) through the WUA to deposit it to the treasurer of the region. At that time, the O&M fund allocation used to be obtained through DIPDA (Regional Budget Proposal for a Project), which was proposed every budgeting year and recommended by DPRD

[60] A paper presented by Sigit Supadmo Arif in the Anniversary of Faculty of Agricultural Technology, UGM, October 3, 2002.

(House of Representative at Regional Level). This mechanism was too slow and lacked transparency. Consequently, most of farmers were reluctant to pay ISF.

In line with the reform spirit, there was a change in the authority of government for irrigation financing. In accordance with the General Directorate of PUOD's circular letter No. 611/3002/PUOD, September 14th, 1998, ISF is collected from, by, and for WUA. Such a decision is addressed to empower farmers so that they develop the capacity for irrigation management and find the resources for funding the O&M cost. Furthermore, irrigation financing is regulated in GR No. 77/2001.

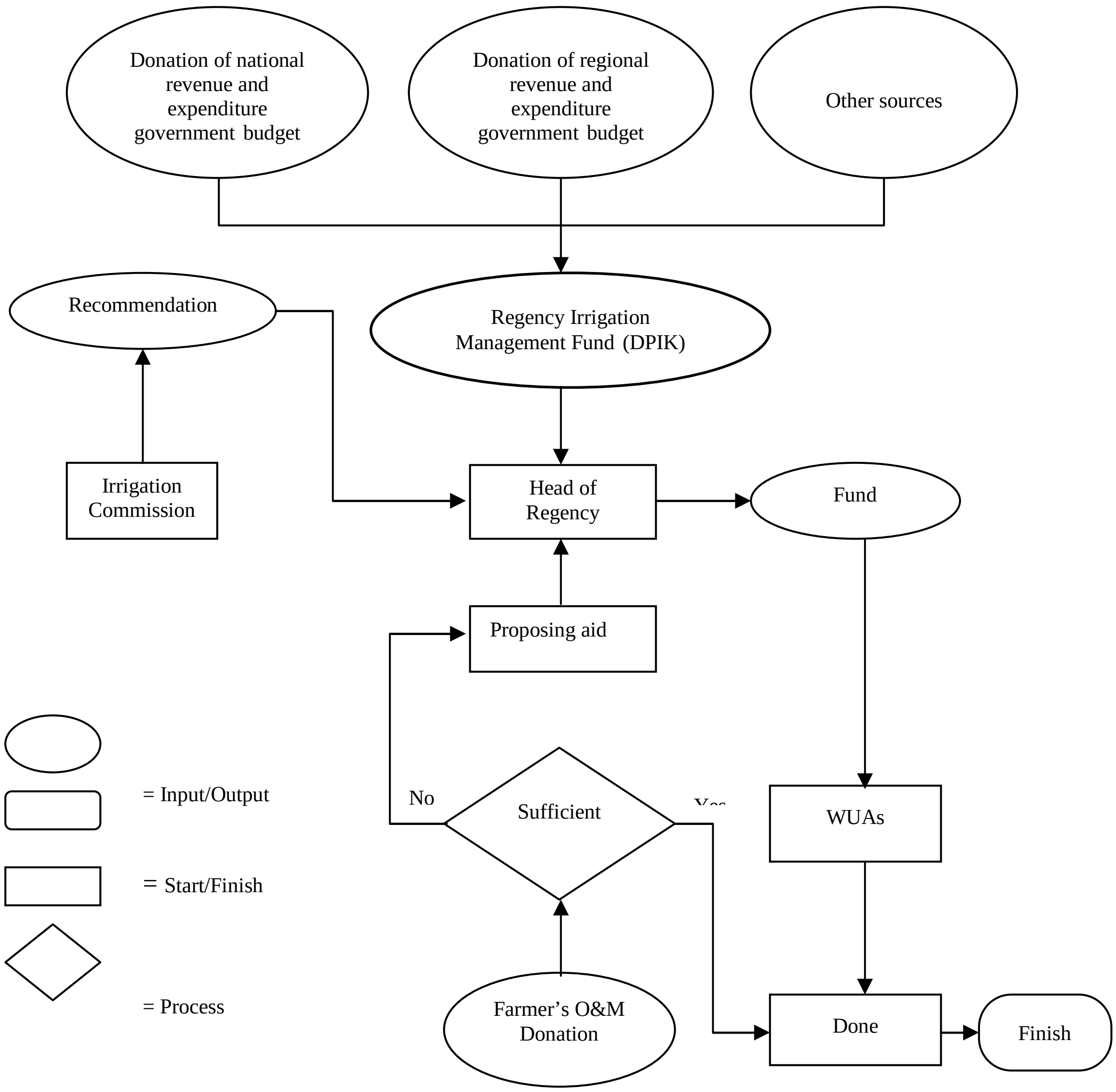
Article 41 of GR No. 77/2001 on irrigation states that the authority in irrigation financing deals with the development of the main irrigation network and financing of irrigation management, constituted by O&M, rehabilitation and upgrading. In line with the article, the government is in charge of financing the main irrigation network while farmers are responsible for providing funds for irrigation management of their authorized network. Apart from this, the government should provide any assistance for funding of irrigation management as agreed by the government and the WUA.

The financial source of the mentioned activities is from revenue and expenditure in the national and regional budget. The WUA sources of irrigation financing management are member development fee, the government aid as well as other sources. The contribution from WUA members may be in the form of routine ISF and development fee or occasional fee and material. Besides, farmers also contribute to the manpower as farmer's participation in irrigation management.

The GR, unfortunately, has not coped with the mechanism of contribution of the central government in the irrigation management fund to the regional government. It will be regulated latter. The irrigation management fund, in accordance with GR No. 77/2001, for efficiency and effectiveness, is given out in the form of the regency's irrigation management fund (DPIK). So far, the governmental fund taken from the national revenue and expenditure budget is aided in the form of a provincial irrigation project.

If the fund is insufficient, WUA, in tune with regional autonomy, is able to propose fund to irrigation commission. In the proposal, the WUA staff should also enclose needed budget, which is composed by members and KPL based on the result of walk through surveys (Decision of Minister of Home Affair No. 50/2001). Later, the irrigation commission will define priority for fund allocation. The complete mechanism of irrigation financing is shown in figure 3.7.4. Nevertheless, to date, the mechanism of irrigation financing has not been done as shown at figure 3.7.4. It is indicated by the fact that the irrigation commission has not been functional as yet.

Figure 3.7.4. Mechanism of irrigation financing (according to GR No. 77/2001).



Of the four selected regencies, policy on IMT has been effectively taking place in Kulonprogo and Magelang. Consequently, the transfer has an effect on the mechanism of irrigation financing according to GR No. 77/2001. Field observations suggest that some farmers in Magelang and Kulonprogo regencies cannot afford the irrigation management fee. So far, WUA has only financed such minor O&M works as sediment dredging, garbage cleaning, grass cutting, leakage fixing and similar other works. Rehabilitation project and heavy network upgrading, for the time being, are handled by the regional government due to farmer's lack of engineering capacity and financial ability. WUAs are unable to handle big projects requiring high technical skills.

Considering the WUA's limited capacity, the Kulonprogo and Magelang regencies still provide stimulant donation for irrigation management for financing of irrigation management after it is transferred. Agreement on stimulant donation in Kulonprogo is laid in the agenda of IMT. Item 1, article 9 of the agenda of IMT states that the regional government provides stimulant donation for O&M with a ratio of 1:4. This means that for every unit of ISF collected, the regional government should provide a 4-unit fund. In the Magelang regency, this ratio is 1:1. The realization of stimulant donation in the Kulonprogo and Magelang regencies is shown in table 3.7.3.

Table 3.7.3. The realization of stimulant donation (Rp).

Regency	ISF (year)	Donation stimulant (year)
Kulonprogo	48,000,000 (2000)	130,000,000 (2001)
	49,987,000 (2001)	173,420,000 (2002)
Magelang	8,000,000 (2001)	12,180,000 (2002)

Source: Head of Magelang and Kulonprogo Irrigation Agency Report.

Research findings show that the amount of farmer's real irrigation expenditure varies from one system to another. The components of real irrigation expenditure are ISF, development fee, and manpower and material. Table 3.7.4 displays farmer's real irrigation expenditure per hectare per annum for each irrigation system studied.

Table 3.7.4. Average of real irrigation expenditure expended by farmers per hectare per annum (Rp/ha/year).

System	Characteristic		
	Head	Middle	Tail
Klambu Kiri	97,757	90,131	50,567
Glapan	35,054	135,397	99,464
Krogowanan	46,583	63,952	11,260
Kalibawang	158,635	114,492	177,678

Source: Primary Data 2002.

The survey shows that farmers of the Kalibawang system in Kulonprogo incur the highest expenditure for irrigation. In the sense of an organization, WUA in this area has been running well so that its mechanism of social control is strongly influential. Organizational activities, such as irrigation fee levying, has been routinely carried out. Real irrigation expenditure covers ISF as much as Rp 15,000/ha/annum, WUA retribution of value of 35,000[61] and incidental retribution of

[61] Based on the survey result on the economic aspect of the study entitled *Pemberdayaan Pengelolaan Irigasi untuk meningkatkan Pelayanan Air Irigasi*, 2001.

value as much as Rp 60,000 up to Rp 125,000. More than 50 percent of ISF is collected. Table 3.7.5 below shows the collected ISF in the regency from 1994/95 to 2001/02.

Table 3.7.5. Target and realization of ISF in the Kulonprogo regency.

No.	Budget year	Target	Realization	Percentage
1.	1994/1995	51,665,781	34,636,456	67.04
2.	1995/1996	56,051,359	37,051,075	66.10
3.	1996/1997	73,856,211	34,610,092	46.86
4.	1997/1998	67,618,932	43,073,892	64.63
5.	1998/1999	46,176,825	27,147,122	58.79
6.	1999/2000	61,300,000	48,000,000	78.79
7.	2000/2001	55,324,000	49,987,000	90.35
8.	2001/2002*	75,000,000	31,423,750	41.89

Source: Report on O&M of the Head of Subdivision of Irrigation, Regional Revenue Board of Kulonprogo Regency.

* Up to September 2002.

A participatory financing system has been prevailing in the Kalibawang system for sometime. Farmers in six irrigation schemes contribute to rehabilitation of any deterioration in the Kalibawang primary canal where the damage value is less than Rp 20 million. If the damage value is more than 20 million, farmers will propose a donation to the government. Unfortunately, the participatory system is not popular in other areas.

On average, real irrigation expenditure in the Krogowanan system is the lowest in comparison to other systems due to abundant water supplies throughout the year. As a result of abundant water supplies, head-end farmers feel reluctant to pay ISF. Farmers in the middle part incur the highest amount of real irrigation expenditure because they have good human resources and the highest crop income. The ISF share to WUAF is Rp 10,000/ha/year. The development fee of WUA, so far, is temporarily collected to rehabilitate any deterioration in the irrigation network.

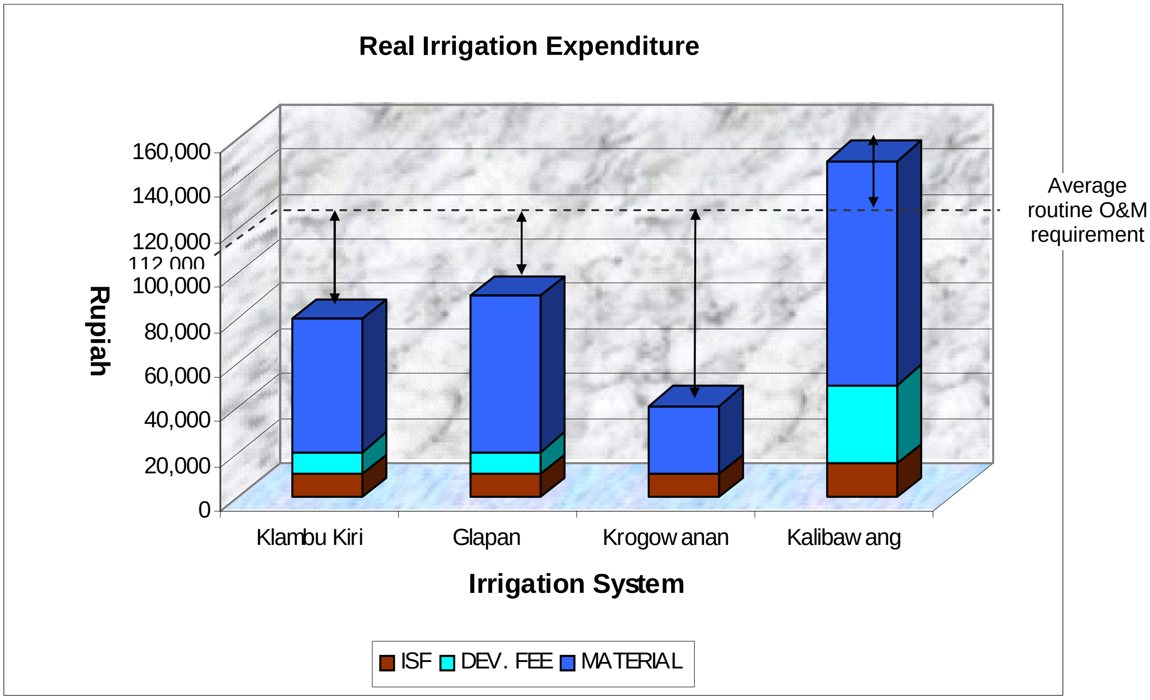
There is a big difference in real irrigation expenditure between tail end and other reaches in the Klambu Kiri system. The tail farmers pay less irrigation fee compared to those in other parts because they generally receive less water. The household survey in DS II shows over 70 percent of tail farmers to have reported that about 0-24 percent of their field was irrigated while about 57 percent of tail farmers got no water at all.

The middle-area farmers of the Glapan system incur the highest real irrigation expenditure compared to those at the head-tail parts. Last year, the middle-area farmers conducted maintenance and rehabilitation activities more frequently, for example leakage reparation, rehabilitation of embankment, rehabilitation of masonry or concrete structure, rehabilitation of supportive structure and gates.

It can be concluded from household surveys that farmers have contributed to financing irrigation management in all the selected systems. The average real expenditure on irrigation is reported in table 3.7.4.

Figure 3.7.5 indicates that farmers' expenditure is not only for O&M funding but also for temporary maintenance and rehabilitation. FTP UGM (2002) suggests that average routine O&M requirement for irrigation schemes in the Kulonprogo regency is Rp.

Figure 3.7.5. Farmer's real irrigation expenditure at the system studied (Rp/ha/year).



112,000 per hectare per annum.[62] Based on figure 3.7.5, farmers' expenditure in the Kalibawang system has exceeded the O&M requirement. In other systems, there existed a gap to be bridged. Therefore, the dialogue between the government and farmers on the allocation of the contribution should be held. The government should consider actual expenditure, as it seems unfair to burden farmers with expenditures that are twice the actual expenditures.

Policy Development and Legal Aspects

Rationale

Irrigation can be thought of as a process to abstract water from its source, convey it through a canal network, distribute it to fields, apply it to crops, and drain the excess water. The process has

[62] Study on Development Irrigation Management Asset in Papah Irrigation Area, Kulonprogo Regency, 2001, Agricultural Technology Faculty, Gadjah Mada University in cooperation with the General Directorate of Water Resource Development,2002.

its objective: to increase the harvest and to reduce the risk of failure due to climatic uncertainty to fulfill food requirement. To meet the objective, the system can be categorized into three subsystems: a) humans as individuals or institutions, which means organization or rules-in-use; b) management system including the capability to provide funds, and c) technology including hardware, software and information that is important to achieve the system objective.

In relation to national reform on irrigation management policy, in the form of GR No. 77/2001 and other related laws, it is necessary to analyze a) whether the laws are pro-poor, and b) how the laws can be implemented in pro-poor ways.

As a policy reform, GR No. 77/2001 has a different objective from the previous national policy. Table 2.4 in chapter 2 briefly describes the differences. The previous policy states that the objective of irrigation is to provide an input to an irrigated agricultural system to enhance crop productivity. The current policy, GR No. 77/2001 in article 2, states that the objective of IMPR is:

"*To benefit water comprehensively, in an integrated way, and with environment consideration as well as to improve farmers' welfare*".

To achieve the goal, principles of irrigation management has shifted to a) farmers as the main actors, b) farmers' necessity as the highest priority, c) management with efficient, effective, polycentric, equity, and sustainable characteristics, d) ultimately to improve farmers' income through farm modernization and diversification. The principles are mentioned in article 4, 5 and 6. The explanation of GR No. 77/2001 states that the principles of irrigation management should be implemented with consideration of the new value in the community, namely, a) consideration to farmers' necessity, b) promotion of crop diversification, c) decentralization, debureaucratization, and devolution, d) democracy, participation and farmers' empowerment, e) accountability and transparency, f) sustainability and consideration on environment and local culture, g) holistic approach, and h) one irrigation system, one management.

The new principles of irrigation management imply a shift in thinking of farming community to be democratic, transparent, accountable, open-minded, and appreciative to technology including irrigation technology. In line with the new paradigm expressed in the new principles of irrigation management, irrigation bureaucracy's authority, role, and responsibility have also shifted from a dominant single authority to be a regulator and a facilitator agency.

The new principle of irrigation management obviously refers to the Dublin Convention, which is pro-poor. The principle also refers to the good irrigation governance.

In line with the laws applied in Indonesia, the study on policy has also been done to analyze GR No. 77/2001 as well as policies of provincial and regency level in selected areas. The provincial and regency policies are drafts of Regional Regulation of Province of Yogyakarta Special Region, Regional Regulation of Kulonprogo Regency No. 17/2002 on irrigation, and Regional Regulation of Magelang Regency No. 7/2002 on irrigation. Regional Regulation of Kulonprogo Regency on irrigation was produced after launching GR No. 77/2001. Regional Regulation of Magelang Regency on irrigation was produced before launching GR No. 77/2001, at the time when IMPR was still in the form of Presidential Instruction No. 3/1999. In addition, two legal products have also been analyzed; they are Ministerial Decree of KIMPRSWIL No. 529/KPTS/M/2001 on method of Irrigation Management Transfer and Ministerial Decree of Home Affairs on the Empowerment of WUAs.

Implementation

The legal aspects of irrigation management cover a) institutions that consist of empowerment and authority transfer, b) approach and implementation of irrigation management constituting water rights, water distribution, O&M, rehabilitation and upgrading, c) financing, d) monitoring, and e) sustainability.

Institution of irrigation management. In GR No. 77/2001, the institutional aspect is stated from article 7 to article 13. The subjects of the articles are:

1. Institution of irrigation management consists of the government (national and regional level), WUA, and all other stakeholders (article 7 [1]).
2. Autonomous WUA in irrigation system management (article 7 [2]).
3. Establishment of Irrigation Commission in regency/ municipal level to assist the regent/mayor in developing irrigation management policy in the area (article 7 [3]).
4. Policentricity principle in irrigation system management (article 7 [4]).
5. Irrigation management transfer (IMT) (article 9 to article 12).
6. Empowerment of WUA (article 13).

Based on the principles of irrigation management, policentricity should be consistently maintained. Article 7 (3) states the elements of irrigation commission but states nothing on working procedures among the related elements. However, article 8 is a hinge to the formulation of the lower-level legal products to deal with the procedures and mechanisms of the relation among elements to ensure irrigation management in regent level, based on dialog.

The GR No. 77/2001 also discusses nothing on the institutional relation among irrigation management in a watershed. Moreover, it has no hinge to the lower-level regulation to deal with it. Nevertheless, this is important in the watershed management, which applies the principle of policentricity in the framework of integrated watershed management with the objective of sustainable irrigation system and management of water resource in a wider scale.

The irrigation management transfer from the government to farmers, one of the points in the policy reform, is accomplished by using the Big Bang method as stated in article 9 (1). This means the simultaneous transfer of management to the ready farmers. This is different from the gradual method stated in Presidential Instruction No. 3/1999 as also conducted in the Philippines.

The IMT is only transfer of management and not an asset transfer. Irrigation assets still belong to the regency government or the provincial government for trans-boundary irrigation systems (article 9 [3]). The transfer can be withdrawn if the WUA is considered as failed based on a management audit conducted jointly by WUA and the government (article 11).

In order to enhance WUA capability to manage irrigation system appropriately, the transfer should follow a condition agreed by WUA and the government. The agreement has to consist of a) WUA as the main manager in the irrigation system, b) an understanding on irrigation infrastructure and its O&M, c) performance indicators to achieve after IMT, and d) performance assessment after transfer. The four important aspects in an agreement of IMT are missing from GR No. 77/2001 and it is possible to regulate them in other legal products as stated in article 12.

In line with the principles of irrigation management, the government is responsible for empowering and facilitating the WUAs (article 13). However, the form of empowerment and facilitation are not regulated in the GR. Article 13 (4) expresses that the autonomous region (regency, municipality or province) should provide a local regulation on the empowerment of WUA.

The formulation of a local regulation should consider diversity of indigenous people. However, the WUA empowerment, as a new characteristic of WUA organization, should consider a) independence in organization, economic and financial, b) ability to access information, c) ability to implement technology, and d) ability to sustain in a dynamic strategic environment, which is progressive. During this transition era, it is difficult for the bureaucracy to recognize the diversity of the area. There are limited statements giving emphasis on the diversity of each region. Therefore, the lower-level legal products should emphasize on the diversity as well as the bureaucracy empowerment besides WUA empowerment.

System of irrigation management. In GR No. 77/2001, the aspect of irrigation management is stated from article 14 to article 40. Water rights are explained from article 14 to article 16. These articles are interrelated with article 27 on the use of water directly from water source.

From the articles, it is clear that the water right, which is a right of a society to utilize water, is weakened by asking permission to utilize water or even permission to allocate water. This is assigned by the government to the owner of water resources and has a powerful authority (article 14, 15 and 27). The Regent/Mayor or the Governor is supposed to issue the permission in consideration of user dialog within river basins based on the policentricity principle.

Article 27 regulates the permission on the utilization of water directly from the source as a spring, lake and groundwater. There is a risk that the government or assigned faction may use the article to endorse its power over the local community. It is contradictory to the policentricity principle stated in other articles. Moreover, it is also contradictory to the efforts of the policymaker to put respect to the local culture, be democratic, and be participatory, based on dialog and equality.

The operation of the irrigation system, which consists of planning, supply provision and regulation, and application of water to crops, should consider how the articles can be implemented to achieve the objective of irrigation. As stated earlier, the objective is to improve people's welfare, specifically that of farmers, through agricultural business modernization and diversification.

A change in the objective means that irrigation management should also shift from protective to productive irrigation system management. Protective irrigation aims to protect failure in agriculture due to climatic deviation, while productive irrigation aims to create a production market as a driving force.

A study on the articles discussed on the operation of an irrigation system found that the articles do not relate to the principles of productive irrigation including the implementation of crop diversification. The crop diversification with market orientation requires a flexible irrigation operation. Articles 18 and 19, however, regulate annual planning of water provision and allocation. This is contradictory to the principle of flexible irrigation with market orientation, which requires seasonal planning based on market demand. Annual planning can be determined as a global planting pattern at a regency level. However, the seasonal planning at system level should be regulated to ensure the flexible irrigation management.

An important clause stated in article 17 (3) assigns the government and local government to ensure the availability of water. This statement assigns the government to conduct the Integrated Water resource Management (IWRM) in their related area. This clause gives a hinge to the lower-level legal product to conduct sustainable IWRM. In addition, the principle of conjunctive use is introduced in article 18 (4) but it requires a detailed implementation regulation to enable sustainable irrigation management.

The subsequent articles on the development of new systems, O&M, rehabilitation and upgrading show the characteristics of democratic irrigation management. Basic regulations on O&M, rehabilitation and upgrading take farmers' needs as priority and place the government and local government as facilitators. Because the principle of irrigation management as well as O&M procedure and mechanism has been transformed, the government facilitation should also be changed. The change is not clearly stated in GR No. 77/2001 so that the lower-level legislation should state the type of facilitation in more detail.

Article 26 on drainage discusses only the drainage network at the main system level, in spite of which, drainage at the tertiary level is essential for comprehensive O&M of irrigation system for crop diversification. Therefore, it is necessary to regulate the drainage system at the lower level of irrigation systems.

Controlling. Controlling of irrigation management after transfer is regulated from articles 36 to 40. They regulate important items, e.g., inventory of the irrigation system, irrigation management audit and asset management plan. The inventory of the irrigation system should be done before IMT implementation and it contains an agreement between WUA and the government on IMT. This inventory provides basic data for a further irrigation management audit. After the IMT, the inventory should be done annually as monitoring activity as a part of controlling.

After the IMT, WUA and the local government have an obligation, as stated in article 37, to conduct irrigation management audit annually. In article 1, an irrigation management audit is defined as activities to assess performance of irrigation systems. The performance consists of aspects of organization, engineering and financing.

In relation to the business aspect of irrigation, the decision should consider cost and benefit. However, this consideration is not explicitly stated in GR No. 77/2001 and only implicitly stated in articles on controlling.

Financing. In GR No. 77/2001, articles related to irrigation financing are articles 41 and 42. The main contents of these articles are a) the national and local government are responsible for financing of the main irrigation network, a) WUA is responsible for financing of its working area, and c) WUA can propose funding aid through the irrigation commission.

The governmental fund for irrigation management is APBN and APBD from national and local governments, respectively. From the local government, APBD is funded through DPIK (regency irrigation management fund). From the national government, APBN goes to the provincial irrigation project. However, the mechanism of each source is not clearly regulated in the GR.

To date, there is no certain institution to manage the DPIK. As a consequence, difficulties arise in the allocation of funds. Furthermore, its affects the efficiency and effectiveness of the use of government funds.

As stated in GR No. 77/2001, the WUA has authority to manage their systems independently. The main funding sources at farmer level are ISF and government subsidy for funding beyond farmers' capability. The government subsidy does not go directly to farmers. The WUA should make a written proposal to the irrigation commission. The irrigation commission gives recommendation to the regent for allocation of funds. GR No. 77/2001 provides no mechanism and criteria for funding allocation. This should be regulated in the lower-level legal product.

Items that are necessary to regulate at the lower-level regulation are a) procedures to propose subsidy for irrigation management under decisions of the Ministry of Finance, b) procedures for government subsidy allocation under decisions of the Regent, c) prioritization in decisions of the irrigation committee, and d) institution of irrigation funding management at the regency level.

Sustainability. GR No. 77/2001 regulates the effort to maintain the sustainability of irrigation systems in article nos. 6, 18, 38, 39, 43 and 44. Efforts to sustain irrigation systems are limiting land conversion from agriculture to other uses and sustaining water resources (articles 43). With support from reliable irrigation water and good irrigation infrastructure, sustainability of the irrigation system is maintained to achieve higher farmers' income (articles 6 and 38).

The articles contain efforts to maintain irrigation system sustainability in relation to physical and environmental aspects. Sustainability is focused on efforts to increase crop production to improve farmers' income. However, irrigation is transformation of the social engineering system. As a transformation of the social-engineering system, the environmental aspects of the irrigation system consists of physical, social and economic, cultural, financial, and political (Arif 1999, 2000). GR No. 77/2001 mentions the relationship among physical, social, cultural, economic and environmental aspects. However, the sustainability of each aspect has not been explained. This requires further regulation from the lower level of legal products.

Problems

Explanation of the legal aspects of GR No. 77/2001 shows that irrigation policy reform has already accommodated the requirement of irrigation management. However, some points need further explanation and regulation as far as its implementation is concerned as presented in table 3.7.6.

Table 3.7.6. Articles that have not been enclosed yet in GR No. 77 and regulation.

Government's Regulation			Implementation of government's regulation			Explanation and recommendation
Aspect	Article	Unexplained problem	Draft of regional regulation of DIY	Regional regulation of Kulonprog Regency No. 17/ 2002	Regional regulation of Magelang Regency No. 7/2002	
Institution	7-13	• Procedure of work mechanism among institutional element of the irrigation commission	Out of province's charge	Has not been addressed	Has not been addressed	It is necessary to regulate in regent's decision letter
		• Institutional relationship among irrigation management actuators in (catchment area) DAS	Article 17 has addressed coordination only	To be addressed in article 150	Has not been addressed	It is necessary to regulate in other regional regulation on IWRM
		• Requirement of agreement between farmers and the government in PPI	Has not been addressed as yet	Has been addressed in article 19 and 20	To be addressed in regent's decision letter on PKPI guidance	It is necessary to regulated in regent's decision letter
		• Forms of aids, facilities, efforts of empowerment by the government	Form of facilitation has been addressed briefly	Effort of empowerment has been addressed in article 18	Explanation of article 10	Has been accommodated by regional regulation of Magelang regency
		• Variety of societal characteristics	Has not been addressed	Has been addressed briefly in article 3 and 5	Has been addressed in article 10, limited to the acknowledgement of traditional institution role and existence	Variety of societal characteristics needs to be emphasized in the Regent's decision letter related to empowerment
		• Bureaucratic empowerment	Out of province's charge	Has not been addressed	Has not been addressed	It is necessary to regulate by the Regent or mayor's decision letter
Irrigation management system	14-40	• A societal group's water right	Reduced to be a proposal to government for taking water	Reduced to be a proposal to government for taking water	Reduced to be a proposal to the government for taking water	It is necessary to regulate in governor, regent, mayor's decision letter on societal group's water right

		• Principles of productive water management thought agricultural business	Has not been addressed	Has not been addressed	Has not been addressed	• Regional regulation on water distribution management is yet based on planting pattern and RTT • It is necessary to regulate in the Regent's/Mayor's decision letter
		• Implementation of more market- oriented planting diversification	Has not been addressed	Has not been addressed	Has not been addressed	It is necessary to regulate in the Regent's/Mayor's decision letter
		• Planning seasonal and depending on market-plant	Has not been addressed as yet	Has not been addressed	Has not been addressed	It is necessary to regulate in the Regent's decision letter
Financing	41-42	• Procedure of DPIK proposal	Out of province's charge	Has not been addressed	Has not been addressed	It is necessary to regulate in decision of the Minister of financial affairs
		• Jurisdictional basis for proposing subsidy at the Regent/municipal level	Out of province's charge	Has not been addressed	Has not been addressed	It is necessary to regulate in the Regent's/Mayor's decision
		• Mechanism of choosing priority by the irrigation commission	Out of province's charge	Be addressed indefinitely in article 22	Has not been addressed	It is necessary to regulate in the Regent's decision
		• Institution managing DPIK	Out of province's charge	Has not been addressed	Has not been addressed	It is necessary to regulate in the Regent's/Mayor's decision
Controlling	36-40	• Procedure of auditing irrigation management	Has not been addressed	Has not been addressed	Has not been addressed	It has been discussed in decision No. 529/KPT/2001 of the Minister for settlement and regional structure affairs
		• Merging plan of asset management for controlling	Has not been addressed	Has not been addressed	Has not been addressed	It is necessary to regulate in the Regent's/Mayor's decision
Continuity	6,8, 38, 39, 43, 44	• Sustainability of irrigation system in socio-economical, cultural, financial and policy aspects	Environmental and physical sustainability is briefly addressed	Financial and physic sustainability is briefly addressed	Environmental and physic sustainability is briefly addressed	They are necessary to regulate in the Minister's decision, Governor's, and the Regent's decision letter

Reform in irrigation regulations has not got any support from other sectors. As a unit of complexities, the reform is expected to be able to achieve the goal of national policy. Therefore, there is an urgent need for support of such other regulations as agricultural policy and poverty alleviation policy. So far, each sector has independently defined its own policy without any coordination with others. Hence, achieving the goal as laid down in articles 2 and 6, it is absolutely necessary to run coordination among institutions and national policies.

Discussion

There are a lot of government regulations that have already been set and issued by the Government of Indonesia to solve the problems related to improving the quality of life of the people (i.e., farmers). However, based on a critical analysis of these regulations, it seems that not many of those regulations are sensitive to poverty alleviation, as shown by some indications as follows:

Constraint and Opportunity

One crucial problem the irrigation institutions face is the lack of socialization, dissemination, as well as public consultation of the new regulation on irrigation management (GR No. 77/2001 and related organic regulations/rules). At the system level, many problems arise in irrigation management. The establishment of WUAs is not always a democratic process. It results from a lack of transparency in irrigation management, lack of controlling mechanisms from members, members not participating in the decision-making process, no accountability report from staff to members, and limited financial capability of farmers and the government. The government pays less attention to O&M financing. On the other hand, farmers have a limited capacity due to decrease in landownership, resulting in reduced incomes.

Dealing with such constraints, it seems that a long period of time is still needed for the process of socialization and dissemination as well as for public consultation of the new system of irrigation management. A controlling mechanism attached to farmers' criticism during and outside the WUA meetings is needed, besides the presence of agents of change (an NGO, a university, etc.) that creates a supporting atmosphere for the existence of transparency and accountability of irrigation management. Dealing with the limitation of the financial capability, participation of farmers in raising funds should be developed besides the efforts to make the government policy more effective in fund allocation.

3.8. SUMMARY AND CONCLUSIONS

Constrains and Opportunities for Implementation of the New Irrigation Management Policy

It is globally understood that the multidimensional crisis in Indonesia was precipitated by the economic crisis, which Indonesia has been experiencing since 1997, following the depreciation of the Thai bath. However, it is also believed that the origin of the crisis was significantly affected by the economic development model adopted by the authoritarian government, which was very fragile and had no strong economic foundation.[1] The reformation movement following the economic crisis has been sociopolitically anticipated by the *newly established* democratic governments under Habibie, Wahid and Megawati as the third, the fourth and the fifth Presidents, respectively, to review overall national development policies and conduct necessary policy reformation at all levels.

The country's irrigation development policy was not an exception. During the last few decades, irrigation development was strongly positioned to support the rice-biased agricultural development for the sake of rice self-sufficiency at an extremely low rice price in favor of consumers. Radical reformation of the national irrigation policy that has been well drafted and socialized through the issuance of several legal documents strongly indicated the need for having more socially sensitive development policies. It seems that such a policy reform is a formal prerequisite; otherwise the agriculture sector would be dampened deeper into its sectoral and structural poverty[2] trap in the next crisis.

In anticipating the need for considering and understanding the principle of people-based irrigation development, in a formal Cabinet meeting in October 1999, the Government of Indonesia formally recommended the application of the participative approach at any stage of irrigation development. In addition, the government established a Working Committee to intensively review existing policies for necessary reform in water-resources development policies. For the case of irrigation, the committee was then formalized on April 26, 1999 with the issuance of the Presidential Decree No. 3/1999 on Pembaharuan Kebijakan Pengelolaan Irigasi, PKPI (Irrigation Management Policy Reform-IMPR) covering five strategic components. In

[1] Agricultural development mismatch was one among primary roots behind the national crisis. Read: Maksum, M. and Dyah Ismoyowati. 2002. CSOs' Role in Enhancing Human Security in Indonesia. In JCIE: Cross-Sectoral Partnership in Enhancing Human Security. Published by JCIE.

[2] Structural issues have been criticized by KIKIS and AUS-Aid as the most dominant factor influencing the emergence of rural poverty in irrigated land. Read: KIKIS and Aus-AID. 2000. Agenda Keadilan dan Pemberdayaan Rakyat: Dialog Nasional tentang Kemiskinan Struktural. Jakarta. It is also cited in Maksum, M. and Sigit Supadmo. 2001. Sectoral and Structural Poverty Syndrome in Irrigated Agriculture in Indonesia. in Hussain, I. and E. Biltonen 2001. Irrigation Against Rural Poverty: An Overview of Issues and Pro-poor Intervention Strategies in Irrigated Agriculture in Asia, Proceedings of National Workshops on Pro-poor Intervention Strategies in Irrigated Agriculture in Asia, International Water Management Institute (IWMI), Colombo, Sri Lanka.

2001, such a policy guideline was then strengthened by the issuance of the Government Regulation (*Peraturan Pemerintah*) No. 77/2001.[3]

Those reform components have been immediately socialized, executed and implemented right after the issuance of the IMPR-1999, to both the district and the provincial governments. Some progress with the implementation of the new pro-welfare irrigation policy package has been well made through that irrigation policy shift in the form of social development covering, among others, empowerment of WUAs and better people participation in irrigation O&M, as well as physical development in the form of the increase in land irrigated acreage and cropping intensity.

However, without nullifying the progress of such a policy shift at the ground level, we have to admit that it is too early to expect that total achievement of the pro-poor irrigation development alone could be materialized in a few years. A total development impact is still being awaited through very long processes. Several lessons have simultaneously accompanied such progress by providing meaningful implementation constraints and opportunities to be considered.

Without disaggregating into detailed components, i.e., the technical, economic and socio-institutional components, selective implementation constraints and opportunities are presented in the following sections before being summarized into the agenda for action.

Implementation Constrains

Institutionally, in the context of the structural dimension of irrigation management, the change from *Orba* to the recent regime means the change from the domination of the central power structure over irrigation management to the people's (society's) power structure. However, time dimension of that change did not allow an enough period for the irrigation system at large, covering the technical, economic and socio-institutional dimensions, to well adjust to the pro-welfare policy implementation as an emerging model.

Such a rapid change and the absence of a transitional period from the old to the new policy system has resulted in: a) the lack of socialization process of the new legislation and policy in the irrigation sector; b) the lack of institutionalization process of the irrigation system, either at macro, meso or system level; c) time lag of the physical and social infrastructure at the system level to adjust themselves to the new policy; d) limited bureaucratic synergy among departments or development sectors which used to work on sectoral approaches in the development for many decades during the *Orba* regime.

In addition to those, based on the fact that irrigation is one among agricultural production factors influencing farmers' welfare, which is strongly dictated by a higher policy system; therefore, the improvement need of irrigation system performance must be generally considered as part of the agricultural development system at the micro, the meso and the macro levels.

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[3] Read: Maksum, Mochammad and Sigit Supadmo Arif. 2001. Paradigmatic Change in the Indonesian Irrigation Development: from Rice-Based to People-Based Policy. Presented at the Regional Workshop on: Pro-Poor Intervention Strategies in Irrigated Agriculture. Conducted by the International Water Management Institute (IWMI) in Colombo, Sri Lanka, 9-10 August 2001.

Among many problems constraining the effectiveness of the new irrigation development policy in attaining welfare improvement of the farmers are the followings

Human Resources Problem

The primary consequences of having a centralistic irrigation development are the human resources of the local government, which have limited ability to identify the local condition and to initiate their decision. Any person attached to the local government used to function as full implementers of the development program. The previous governance structure had never invited the participation of the local government in the planning and decision-making processes.

Likewise, farmers who previously acted as net recipients of any government program at the grass-root level had been very apathetic in managing their irrigation system. In addition, farmers, who used to manage the tertiary block, have a very limited knowledge about the whole irrigation system. As a consequence, necessary measures need to be formulated towards strengthening institutional capacity of both the local government and the farmer institution in the newly defined irrigation management.

Sociocultural Diversity

The centralistic government model formerly adopted by the country has been proven as having very limited accommodation to the locality. There was a tendency for adopting a heterogeneous development program among localities all over the country. The diversity of socioculture in each region has never been taken into consideration in local development. It is not very surprising to find the fact that the majority of irrigation development has limited achievement due to sociocultural constraints.

Under the newly reformed irrigation development policy, locality consideration is very well accommodated to improve overall performance of irrigation systems. A people-based O&M of an irrigation system is started to be created by recognizing the local condition and capacity. However, during these early years of IMPR implementation, technical skills need to be improved in accompanying the shift from having very homogeneous development models towards locality-based irrigation-development models.

Limited Available Data and Information

When water-resources management was fully centralized, public awareness on the need for safeguarding field equipments and measuring devices was very poor, while data availability connected with water-resources development is still very poor. Due to this fact, coupled with the fact that information system management in water resources was not being prioritized, appropriate basic data and information related to water-resources management are not standardized and insufficiently available. Consequently, it is difficult to continuously monitor the irrigation system performance and provide accurate information for O&M planning.

Weakness of the Management Function

The former development management in the country was strongly dictated by sectoral development approaches. After several decades of experience in adopting such sectoral approaches, it was found out that water-resource management in Indonesia, which was supposed to be built under integrated management, was proven to be strongly constrained by significant weaknesses in management coordination among sectoral institutions concerned. Since the performance of the irrigation system is a product of interaction among many factors, weak management functions resulted in poor performance of the irrigation system.

Disarraying Institutional Commitment

The irrigation management policy reform (IMPR) has been taking effect since it was formulated in 1999 and strengthened through the issuance of GR No. 77/2001. However, the shift in the paradigm and orientation from the very centralistic nature to the decentralized one without proper preparation has created various responses to that rapid change at all levels.

At the grass-root level, the readiness of the overall irrigation system in accommodating such paradigmatic changes needs several measures to smoothen the system in attaining its effectiveness in providing people's welfare, whereas, at the meso level, the readiness of the district government to accelerate local development connected with decentralization and regional autonomy is still a serious problem in understanding any newly shifted development model including IMPR.

It is also not very surprising to find that, at the macro level, government consistency and political commitment to the implementation of IMPR and GR No. 77/2001 are still in a serious disarray. Although IMPR has been formally proclaimed as the new irrigation policy guideline through the issuance of GR No. 77/2001, interdepartmental coordination at the national level is poor.

Without nullifying the fact that IMPR implementation at the ground has been facing various constraints, strong resistance of the Ministry of Resettlement and Regional Infrastructure against irrigation management transfer to the farmers and district irrigation financing (DPIK), vis-à-vis the Ministry of Home Affairs, the Ministry of Agriculture and the National Development Planning Agency, could be considered as a serious disarray and poor government commitment, as far as IMPR is concerned.

Rice-Based System Design

The Indonesian irrigation system development has been strongly focused to support the rice self-sufficiency policy for decades. As far as the self-sufficiency objective is concerned, irrigation contribution has been very remarkable. It was characterized by the attainment of the country's self-sufficiency in rice in 1984. However, when the irrigation policy was changed from the rice-based towards the welfare-based policy, such remarkable contribution was found to be the most constraining factor in the welfare perspective. Irrigation infrastructure was not very flexible in accommodating the crop and cropping selection of farmers in reflecting their welfare-based objective of farming through crop diversification.

Weaknesses in Intersectoral Network

Although it is very well accepted that irrigation is considered as a critical production factor in irrigated agriculture, irrigation is merely one among many agricultural production inputs. Due to this condition, therefore, the effectiveness of any pro-poor irrigation intervention will always be determined by agricultural economic performance. Based on the fact that agriculture and rural sectors of the country have been significantly marginalized in the national economic development of Indonesia, especially by the former regime, socioeconomic performance of irrigation needs to be enhanced.

In addition to such agriculture marginalization, it could be noticed that the most crucial limitation of agricultural economic performance is the poor inter-linkage synergy among development sectors connected with agriculture. Under the new-order government, sectoral approaches strongly characterized national development. This resulted in partial development of agriculture which has been very successful in providing food supply without being accompanied by meaningful welfare improvement of the farmers.

Limited Support of Socioeconomic Infrastructures

Agricultural support system still needs to be improved for increasing socio-economic performance of agriculture. Pricing policy, input price, agricultural subsidy, farm credit, village cooperative and extension services, are among support systems which are reported as increasingly poorer from the view of the farmers. Consequently, those significantly resulted in the ever-decreasing terms of trade of irrigated agriculture.

On-Farm Technological Constraints

Only a few research sites performed excellent diversification practices at the farm level, while, more such sites experienced a poor diversification performance. Extremely poor diversification performance could be easily observed in the Glapan and Klambu Kiri systems due to limited availability of irrigation water and land suitability condition. In those sites diversification was practiced poorly and provided poor production performance. It must be realized that the availability of diversification technology is still limited, especially in the areas characterized by seasonal drought.

Land Size and Off-Farm Employment

Employment in the country's modern sector has been successfully developed by the state during the former regime. However, industrial bias in economic development of the country has resulted in serious backwardness of rural development. When urban employment was significantly enlarged, there was no alternative source of income in rural areas. Both non-farm and off-farm employment were getting more limited. In turn, agricultural activities could be said as the only source of income in rural areas.

Consequently, population increase has made the agriculture sector to become more overburdened. At the same time, the limited availability of rural employment resulted in the decrease in the land-man ratio all over the country, wherein a more significant decrease was shouldered by irrigated area in Java. Fragmentation of landownership due to the inheritance system has resulted in the size of landownership becoming smaller and less-effective in any agricultural development and innovation.

Without disregarding other factors determining agricultural productivity, including irrigated water availability, technology adoption, relative position to the source of water, market accessibility, etc., the study found that the size of landownership dominated by those having an average land size of around one-fourth of a hectare was proven to be the most significant variable determining agricultural income and poverty.

Implementation Opportunities

Besides the constraints accompanying the shift in the irrigation-development paradigm, optimism in attaining a remarkable improvement of irrigation system is guaranteed and supported by several development opportunities recently provided in the country. Major changes precipitated by the change in irrigation management policy reform (IMPR), which was initiated right after the change in the Indonesian governance system after the turning over of the country's leadership to President Habibie in 1998, could be considered as the most significant opportunity for enhancing irrigation development for poverty alleviation.

Although many problems were found to be important in constraining the pro-poor policy effectiveness during the early years of implementation, formulation of several legal documents was believed to be a strong development foundation and opportunity for overall system components to adjust in materializing the welfare objective of irrigated- area development.

Among many other opportunities, they are:

Decentralization and Regional Autonomy

Paradigmatic changes from an extremely centralistic governance to decentralization and regional autonomy, accompanying sociopolitical reformation right after Soeharto stepped down as the second President, was considered by many as the remarkable basis for the country to move into democratized governance accommodating a better role of the private and community-sector participation in development.

Moreover, decentralization and regional autonomy, as nationally proclaimed by the country through the issuance of the Law No. 22/1999, allows to accommodate local potential and participation in development. Law No. 22/1999 has provided a greater role and opportunity to local governments to initiate and decide in developing specific management systems suitable to their respective localities.

Development decision making and public financing have been brought down to the level of District Government and local stakeholders at large. Though it must be understood that the policy shift effectiveness is still in the form of a "learning process" and strongly influenced by public euphoria, development dynamics at the bottom level has been transmitted towards better conditions in favor of the locals.

At any condition, since the shift was closely connected with the right of the local people to claim in relation to the country's democratization, it seems less likely that decentralization and regional autonomy will be reshuffled and brought back into recentralized governance. As a sociopolitical choice of the country, they must go on regardless of the fact that early implementation of them was characterized by euphoric power adjustment among district governments and between the district and central governments.

Irrigation Management Policy Reform (IMPR)

As far as irrigation development is concerned, policy packages formulated by the irrigation management policy reform were very remarkable in initiating the necessary foundation for the pro-poor irrigation development. Such a policy package, which was drafted by irrigation management specialists from several universities since 2001, has been getting public legitimacy through intensive public consultations for months before being proclaimed as an acceptably stronger policy measure.

That irrigation management policy reform, which was finally strengthened through the formalization of GR No. 77/2001, has a clear objective to improve farmers' welfare. This policy provides a legal basis for better irrigation management, which leads to the performance improvement and farmers' welfare. However, several efforts still need to be done to strengthen the effectiveness of IMPR implementation because there are several groups still resistant against IMPR and GR No. 77/2001.

In addition, the future of IMPR and GR No. 77/2001 is expected to be intensified by the forthcoming issuance of the Law on Water Resources which is currently being intensively discussed in the parliament. Otherwise, IMPR and GR No. 77/2001 would never be effective and the irrigation development would be recentralized without any certainty of future development.

A serious problem is currently observed in the legal discourse and political movement during the discussion of the legal draft of the law on water resources. Without nullifying the need to review and strengthen GR No. 77/2001, it must be kept in mind that the new values as have been mandated by that regulation have been relevant with the spirit of, among others, bottom-up development, public participation, transparency and decentralized governance as being clearly instructed by Law 22/1999.

Based on that reason, supported by the fact that several district governments have started to initiate the issuance of district regulations connected with IMPR, the Indonesian Parliament should take serious consideration on the existence of the real need to effectively protect GR No. 77/2001 as an ongoing public aspiration down there at the grass-root level. Otherwise, irrigation development will be trapped in a more serious disarray.

Natural Conditions

The natural conditions in Indonesia are favorable for agriculture. Situated along the equator with sunshine throughout the year, abundant rainfall and volcanic soil, there are many opportunities to improve irrigation system performance. However, it is important to maintain the sustainability of the natural environment so that it can support human life for a long time.

One interesting issue that needs to be raised in connection with the natural capacity to shoulder the responsibility for irrigated agricultural development in Indonesia is closely related with river-basin management. The ever-decreasing capacity of the river-basin system has been raised by many as influenced by the lack in interinstitutional coordination in water resources management. Under an integrated management approach, it could be expected that the natural condition of the basin could be improved to shoulder the responsibility for the nationwide irrigated agricultural development.

Indigenous Knowledge and Technology

Agriculture has been practiced as a tradition for centuries in Indonesia. Indigenous knowledge related to cultivation has been developed over time. As an illustration, *pranata mangsa,* a Javanese method to determine time for cultivation based on the sun position and climate, is proven to be a very accurate cropping management tool for Java and Bali. It is necessary to improve this type of local knowledge to develop the most appropriate action to improve irrigation system performance.

In addition, local knowledge and technological capacity directly show the willingness of local people to participate in their local irrigation development. Irrigation management has been part of their life for decades. However, such potential has been marginalized by the government by taking over and monopolizing irrigation development.

Based on that fact, therefore, turning over irrigation management to farmers could be considered as a must. It is just giving back the right and responsibility of the farmers. While, the function of the government has to be shifted towards supporting, facilitating and enabling the farmers or farmers' associations in regaining their capacity to manage local resources in their respective villages.

Diversification Potential

Agricultural diversification has been part of the tradition of our tropical farmers since the ancient times in actualizing their survival strategy. The potential has been there at the grass-root level since centuries. However, in facing global movement for agricultural competitiveness, such a potential needs to be strengthened by providing an alternative diversification technology adoptable by the farmers to face the global arena.

For Indonesia, diversification technology research and development (R&D) are very important to be promoted because it had minimum progress during the industry- and rice-based national development over the last three decades.

Supporting Policy Measures

Supporting policy measures for irrigated area development have been provided excellently. Socioeconomic infrastructure has been well installed and made effective. This covers, among others, the village unit cooperative, pricing policy, international trade policy, credit distribution in favor of the smallholders, rural banking development and market development. However, their existence is still far from being effective in favor of the poor farmers.

The problem of effectiveness has been raised by many as getting more serious. To take a concrete example, pricing policy has been formulated for several agricultural products. However, it has never been very effective in protecting the welfare of the people at the grass-root level. The implementation of such a policy was not being accompanied properly by local price assurance to the farmers and without being protected from illegal import.

3.9. STRATEGIC INTERVENTIONS IN IRRIGATED AGRICULTURE

Considering the constraints and opportunities, some pro-poor intervention strategies can be suggested as an agenda for action in improving irrigation system performance in favor of poor farmers. After priority selection, the study strongly recommended the following agenda:

Irrigation System Redesign

The existing irrigation system and its management were designed to strongly support only rice self-sufficiency without being adjusted to accommodate the adoption of the non-rice commodities. When IMPR is made effective, design suitability of the system is poor to support technological choices of the farmers in agricultural production. Consequently, a free commodity choice is hardly possible due to the irrigation-system constraints.

To accommodate agricultural diversification, which is strongly believed to be an effective way in actualizing the pro-poor agricultural practice, a serious design study needs to be conducted towards a standardized system design adjustable for agricultural diversification. Redesign of the water resources system is considered as a must for poverty alleviation purposes at the farmer level.

Participatory O&M Manual

Before the implementation of irrigation management policy reform, the water management procedure applied in Indonesia was the centralized O&M system. After IMT implementation, O&M are conducted based on the local condition of each system including the capability of the WUA. Therefore, each system needs an O&M manual that is participatorily developed by the WUA members. This participatory O&M manual is expected to produce better performance than the previous nationally uniform O&M system.

Training Needs Assessment for Local Government Officials

Capacity building for local government officials is considered as urgent because presently they have a different role and face different challenges. A training needs assessment is important to develop the most suitable program of capacity building, especially because current observation has found a very diverse interpretation of IMPR and its implementation among bureaucrats.

Training Needs Assessment for Farmers

Similarly, farmers in WUA, who become managers in their own irrigation system, need capacity building as well. The training needs assessment should cover aspects related to irrigation, agriculture, organization and management.

Asset Management Plan

It is a proven fact that the condition of irrigation system network affects the water delivery performance. The asset management plan provides farmers and the government with a tool for maintenance of irrigation structures.

Information System

Development of agribusiness in the irrigation system to improve benefits for farmers requires an information system. This system includes the information on climate, real-time water availability, market and so on.

WUAs Institutional Strengthening

Institutional aspects, including administrative, organizational, sociocultural and technical aspects of the strengthening effort of WUAs is required to bring move them forward in accordance with the quality suitable to the newly shifted position of WUAs in irrigation management. The same strengthening effort is also required for building the capacity of other local institutions connected with agribusiness development including farmer groups, local cooperatives, micro-credit system, etc.

Capacity Building of Government Institutions

This is concerned with the need to bring government institutions to be capable of formulating the necessary implementation of regulations connected with the newly reformed irrigation management. Such a strengthening effort must also cover the ability to promote local partnership towards balanced participation of the state, private sector and civil society organizations (CSOs) including NGOs, universities and CBOs in supporting the pro-poor irrigation and agribusiness system development.

Strengthening Inter-Sectoral Network

Pro-poor institutional strengthening of the socioeconomic infrastructural institutions include, among others, village unit cooperatives (KUDs), extension workers, rural banking, agricultural market and storage systems.

R&D Promotion

Functional strengthening of the research and development (R&D) institutions in technological development connected with the newly formulated irrigation and agribusiness development unnegotiably needs to be promoted.

Above all, the consistency of the pro-poor development policy related to the irrigation, agricultural production, industrial and trading subsystems, needs to be strengthened and effectively implemented. Otherwise, IMPR implementation would never be very effective in promoting people awareness and participation in promoting socioeconomic protection, human security enhancement and self-alleviating poverty in rural areas.

Needless to say, the shift from a very centralistic to a very decentralized governance in irrigation is not an easy task to realize. The shift from the former to the new paradigm in irrigation development unnegotiably needs many prerequisites. Those needs were rationally based on the fact that mobilizing people participation in development at the grass-root level is not an easy task after being domesticated as net recipients of any state-centered development. Without fulfilling such prerequisites, IMPR implementation would never be very effective in attaining its objective in irrigation development, but rice production.

Appendix 1

Composition of Household Yearly Income into Farm and Non-farm Components

Table 1 shows that respondents in all irrigation systems practice the off farm labor and trading. Types of off farm labor are as inconsistent job, cigarette labor, and home industry. The context of trading in this paper is means such small trading as selling daily vital things both food and non-food in grocery. Trading is the choice of farmer respondent if they have nothing else to do. However they always leave it because they do not have enough assets. Some of them want some loan to increase their capital. Other sources of off farm income are salary, retirement allowance, and rent in payment, sharecropping land, loan and others. All in study area, some respondents receive money from their family who lives in another city to support their life.

Table 1. Off-farm job income and other income source.

Explanation	Klambu Kiri system			Glapan system			Krogowanan system			Kalibawang system		
	H	M	T	H	M	T	H	M	T	H	M	T
Farm labor		√	√	√	√	√	√	√	√	√	√	√
Of-farm labor	√	√	√	√	√	√	√	√	√	√	√	√
Trading	√	√	√	√	√	√	√	√	√	√	√	√
Service			√		√	√		√	√	√		
Driver		√										
Motorcycle/ peddler driver		√		√	√		√	√	√	√	√	
Salary	√	√	√	√	√	√	√	√	√	√	√	√
Retirement allowance			√	√		√	√	√	√	√	√	√
Receive money	√	√	√	√	√	√	√	√	√	√	√	√
Rent in payment	√	√	√	√	√	√	√		√	√	√	√
Sharecropping land			√		√	√	√	√	√	√	√	√
Loan	√		√	√	√	√				√		
Others	√		√	√	√							

Source: Primary data, 2002.

Appendix 2

Composition of Household Yearly Expenditures to Non-farm Components

Table 2. Consumption of food per household.

	Klambu Kiri			Glapan			Krogowanan			Kalibawang		
	H	M	T	H	M	T	H	M	T	H	M	T
Rice - (kg / day)	0.89	0.72	0.90	0.98	0.92	0.96	0.82	0.87	0.76	1.09	0.78	0.96
Rice - (kg /year)	320	259	325	352	331	347	344	405	313	432	353	402
Maize – (kg/day)							0.00	0.00		0.00		
Maize – (kg/year)							0.47	3.64		0.09		
Cassava–(kg/day)							0.01	0.00	0.00	0.03	0.00	0.07
Cassava–(kg/Y)							17	9	7	14	4	27
Sugar–(kg/day)	0.01	0.01	0.01	0.01	0.01	0.01	0.16	0.22	0.16	0.16	0.12	0.12
Sugar – (kg/year)	21	22	27	23	24	23	66	86	67	59	55	48
Coffee (pack)	22	8	10	3	8	4	10	33	27	23	20	14
Tea (pack)	19	17	15	23	22	32	128	137	90	65	51	61
Cigarette (pack)	143	130	144	80	154	160	175	176	306	114	150	151

Source: Primary Data 2002.

The average rice consumption per day per family is less than one kilogram, except for head part of Kalibawang system, where the consumption is 1.08 kilogram per day (table 2). The rice substitutions for the farmer respondent in Krogowanan system and Kalibawang system are maize and cassava. The sugar consumption is the highest in Krogowanan system, and so are coffee, tea and sugar consumption.

Table 3. Meal cost per year (Rp).

System/Characteristic	Daily	Yearly
Klambu Kiri		
- Head	5,958	2,151,398
- Middle	8,987	3,245,258
-Tail	7,270	2,635,248
Glapan		
- Head	5,982	2,159,435
- Middle	6,912	2,493,571
- Tail	7,463	2,692,390
Krogowanan		
- Head	3,804	1,705,098
- Middle	3,803	1,841,970
- Tail	4,029	1,645,441
Kalibawang		
- Head	4,071	1,621,613
- Middle	3,725	1,654,422
- Tail	2,863	1,245,815

Source: Primary Data 2002.

The average cost of meals per day per family of the farmers in the Klambu Kiri and Glapan systems are higher than that of the Krogowanan and Kalibawang systems (table 3). The farmer family in the Klambu Kiri system and the Glapan system spend Rp 7,405 per day and Rp 6,786 per day, respectively. At the same time, in Krogowanan and Kalibawang systems, the expenditure of meals per day is less than Rp 4,000; they are Rp 3,879 and Rp 3,553, respectively. The cost of basic needs material in the Glapan and Klambu Kiri systems is more expensive than that of the Krogowanan and Kalibawang systems.

The difference in the cost between consumption of food and the meal is the expenditure for rice, sugar, tea and so on. It amount to Rp 5,418 in Klambu Kiri. In Glapan, Krogowanan and Kalibawang it amounts to Rp 5,746, Rp 4,752 and Rp 4,571, respectively. Unlike the meal cost, the range of food expenditure is not wide, which indicates that the difference in the cost among them is not high. Table 4 shows the total consumption of food costs.

Table 4. Total consumption of food cost (Rp).

System/ Chrst	Daily	Monthly	Yearly
Klambu Kiri			
- Head	11,091	342,942	4,128,442
- Middle	14,272	456,362	5,476,345
-Tail	13,105	418,341	5,020,094
Glapan			
- Head	11,251	356,223	4,274,689
- Middle	12,696	401,829	4,821,948
- Tail	13,649	434,289	5,211,468
Krogowanan			
- Head	8,589	261,055	3,808,667
- Middle	8,950	285,787	4,346,075
- Tail	8,352	259,547	3,507,741
Kalibawang			
- Head	8,770	267,900	3,506,227
- Middle	8,286	247,046	3,627,167
- Tail	7,315	221,759	2,975,989

Source: Primary Data 2002.

Calculation of agriculture input cost includes the cost of sharecrop, cost of land rent and other costs as shown in the table 5.

Table 5. Other costs per year (Rp/ha).

System/ Characteristics		Cost of sharecrop	Cost of land rent	Land tax	Ceremoni al	ISF	Others	Total
Kl. Kiri	H	314,215	693,562	34,410	6,048	97,757		1,145,994
	M		3,231,709	25,489	46,693	90,131	222,110 (pump)	3,616,134
	T	169,698	963,466	16,293	6,077	50,567		1,206,102
Gl	H	74,073	1,298,225	47,428	4,817	35,054		1,459,600
	M	54,777	392,933	70,766	10,571	135,397		664,446
	T	822,117	775,290	55,836	3,632	99,464		1,756,340
Krgw	H	718,062	2,790,667	65,932	123,568	46,583	1,171,745	4,916,559
	M	947,705	1,355,545	56,921	55,868	63,952	2,375,000 (mulch)	4,854,987
	T	1,091,880		22,040	3,036	11,260		1,128,218
Kl Bw	H	2,121,724	222,682	74,665	115,306	158,635		2,693,015
	M	1,143,805	721,993	45,840	31,710	114,492		2,057,842
	T	836,654	188,190	70,000	100,894	177,678	1606	1,375,022

Source: Primary Data 2002.

The farmers in Krogowanan system spend the highest of agriculture cost. It is then followed by farmers of Kalibawang system, Glapan system and Klambu Kiri system. Total cost of agriculture is shown in the table 6.

Table 6. Average of other costs per year (Rp/ha).

Klambu Kiri	Glapan	Krogowanan	Kalibawang
1,989,410	1,293,462	3,633,255	2,041,960

The farmers in the Krogowanan system, especially in the head and middle areas, spend the highest cost for mulching, besides land rent. In the Kalibawang system, the highest cost is sharecropped cost. The farmers in the Klambu Kiri system must pay for pump operation especially in the middle area.

Table 7. Total non-food and nonfarm expenditure per farm per year.

System	Characteristic	Total (Rp)
Klambu Kiri	Head	3,541,261
	Middle	6,514,717
	Tail	4,532,836
Glapan	Head	5,491,032
	Middle	5,714,631
	Tail	4,520,342
Krogowanan	Head	3,445,481
	Middle	3,958,019
	Tail	3,563,088
Kalibawang	Head	3,952,346
	Middle	4,543,532
	Tail	3,500,186

Source: Primary Data 2002

The cost of nonfood and nonfarm that a farmer spent per year is Rp 4,862,938, Rp 5,242,002, Rp 3,655,529 and Rp 3,998,688 in Klambu Kiri, Glapan, Krogowanan and Kalibawang, respectively (table 7). Percentage of this consumption by kind is shown in table 8.

Table 8. Percentage of consumption of nonfood and nonfarm cost by kind.

Kind	Klambu Kiri system			Glapan system			Krogowanan system			Kalibawang system		
	H	M	T	H	M	T	H	M	T	H	M	T
1. Clothes	8.91	8.66	8.85	6.27	5.82	7,87	9.98	6.00	11.85	4.58	4,27	5.63
2.House rehabilitation	17.10	26.76	10.50	28.87	17.17	12,79	8.89	8.36	3.38	19.20	8,98	11.69
3. Furniture	4.34	3.76	2.97	2.73	8.42	2,04	2.23	4.02	0.26	2.14	2,38	3.05
4. Health care	17.20	11.47	13.83	12.53	10.49	13,51	13.11	9.76	11.16	14.71	16,06	16.50
5. Social activity	12.22	12.60	14.70	6.60	12.02	11,35	22.18	19.49	15.66	18.10	22,84	19.39
6. Lighting/fuel	11.73	9.65	13.84	10.37	10.51	13,77	13.51	14.26	10.55	11.43	12,60	11.81
7. Recreation	4.00	1.66	3.34	2.59	1.16	0,67	2.60	3.69	1.88	2.27	2,81	2.28
8. Saving	1.01	0.26	1.52	2.78	1.63	8,13	1.78	0.08	2.11	1.20	5,53	1.79
9. Education cost	19.77	20.13	26.31	20.37	27.08	24,81	21.37	24.15	36.70	21.81	15,72	24.64
10. Tax	1.87	1.77	2.01	1.65	1.35	2,12	1.15	1.91	1.58	1.77	2,00	1.61
11. Repair	1.84	3.27	2.14	5.23	4.35	2,95	3.19	8.28	4.86	2.79	6,81	1.61
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Source: Primary Data 2002.

The percentage of the cost allocation differs from one system to another. Nevertheless, from these data it can be concluded that the farmer respondent spends the highest cost for the educational sector. It is more than 20 percent of the total expenditure, except in the head of Klambu Kiri system and the middle of the Kalibawang system. Educational expenditure of the tail area of the Krogowanan system is 36.70 percent, which is the highest compared to other places. Such social activities as the wedding contribution also cost much. In the Krogowanan and Kalibawang systems it is more than 18 percent (except at the tail of the Krogowanan system). The average of the social activity cost at Klambu Kiri and Glapan is 12 percent, except at the head area of Glapan where it is just 6.60 percent. The middle area of Kalibawang and the head area of Krogowanan have the highest social activity cost, which is more than 22 percent.

Appendix 3

Housing

Result of the survey of 900 respondents show that more than 90 percent the status of the house is ownership. Most of the houses are made of bricks, especially in Kalibawang and Krogowanan. In Klambu Kiri only 51.04 percent of houses are made from of bricks, while 35.56 percent the house are made from board. In Kalibawang, 92 percent of domestic water is groundwater. Respondents in Krogowanan, Glapan and Klambu Kiri had groundwater as the domestic water source are 87 percent, 80 percent and 55 percent, respectively. In all systems more than 90 percent of respondents stated that the quality of the domestic water was good, except for the Glapan system, where only 64 percent of the family respondents said so. There are 39 percent respondents in Klambu Kiri and 37 percent in Krogowanan who have to pay for their domestic water. Total payments to bring water per month is shown in table 9.

Table 9. Payment for transporting domestic water per month per household.

System	Characteristic	Total (Rp)
Klambu Kiri	Head	20,418
	Middle	17,329
	Tail	14,433
Glapan	Head	24,666
	Middle	11,990
	Tail	28,500
Krogowanan	Head	946
	Middle	6,500
	Tail	1,300
Kalibawang	Head	7,500
	Middle	12,333
	Tail	11,000

Source: Primary Data 2002.

The houses of the family farmers have supporting facilities, for instance electricity connection, telephone, car and motorcycle. Electricity is available in almost all respondent housings. Only 0.29 percent respondents of the Kalibawang system have no electricity connection in their houses. This number is considered small compared to 250 respondents. The use of gas stove is relatively small, that is less than 10 percent. Similarly the use of telephone and computer is relatively small. However, television and radio are commonly used by respondents. Table 10 shows the percentage of households supporting in infrastructures.

Table 10. Percentage of households supporting infrastructures.

	Klambu Kiri	Glapan	Krogowanan	Kalibawang
Electricity connection	100	100	100	99,71
Gas	6,67	4,46	9,49	4,87
Telephone	5,99	4,02	6,43	0,79
Personal computer	1,01	0,74		1,58
Television	86,35	82,49	87,82	90,74
Radio	68,17	79,35	89,27	93,19
Car	5,07	3,47	1,97	0,33
Motorcycle	38,93	55,53	31,73	47,9
Bicycle	95,7	95,98	46,01	83,91

Source: Primary Data 2002.

Appendix 4

Socioeconomics of Households in Rain-fed Areas

The number of respondents for the rain-fed area is 100, while the average age of farmers is 53.48 years. The average number of family members is 3.43 persons and the main occupation is farming, including farm labor.

Table 11 shows that the average size of landholding per farmer in the rain-fed area is 0.07 –0.1 hectare. It is smaller than that of the irrigated area. The amount of rented agricultural land is relatively small.

Table 11. The average size of land (ha)

	DS II	Rainy season	DS I
Owned land	0.07	0.10	0.10
Rented in	0.01	0.02	0.02
Rented out			
Operated land	0.08	0.12	0.12

Source: Primary Data 2002.

Rice is the dominant crop in the rainy season and DS I (table 12). Other crops are grown during these seasons are maize and soybean. Farm income per household per year is Rp 533,796 and per hectare per year it is Rp 4,804,434.

Table 12. Percentage of crop income.

No.	Crop	Percent
1.	Rice	61.65
2.	Maize	23.58
3.	Chili	3.77
4.	Kacang benguk	0.22
5.	Soybean	10.37
6.	Tomato	0.41
	Total	100.00

Source: Primary Data 2002

Farm household income comes from several sources, i.e., food crop, perennial crop and livestock (table 13). Livestock is the main source of income of the farmers in rain-fed area. The total farm income is Rp 2,184,096 per year.

Table 13. Percentage of farm income per year.

No.	Source	Total (Rp)
1.	Food crop	24.44
2.	Perennial crop	09.32
3.	Livestock	66.24
	Total	100.00

Source: Primary Data 2002.

Off-farm jobs are an important source of income for farm households in the rain-fed area. Titles of some common off-farm jobs available in the rain-fed area are farm laborer, trading, home industry, driver and services. Wife usually works as home industry laborer and small trader. It is difficult to get off-farm jobs in the rain-fed area.

Unlikely in the irrigation area, off-farm income is more than farm income, i.e., Rp 2,370,291 or 52,04 percent of the total income. The total income from both farm and off- farm is Rp 4,554,386.

The farmers in the rain-fed area have not met their daily needs. According to the survey on expenses, they spend Rp 3,003,552 and Rp 4,119,130 on food expenditure and non-food expenditure, respectively. On average, a household farmer must spend Rp 2,568,296 extra every year.

Appendix 5

Water User Association

Table 14. Respondent opinion on the existence of the WUA

Aspect	Kalibawang system	Krogowanan system	Glapan system	Klambu Kiri system
Percentage of respondent stating that the members of the WUA are:				
- Owner	41.28	54.93	72.61	45.59
- Farm laborer	58.15	43.70	27.39	53.03
- Others	0.57	1.37	-	1.38
Percentage of respondent stating that members of the WUA staff are elected by discussion	87.83	76.75	85.25	91.94
Percentage of respondent stating that members of the WUA staff are active	93.01	76.17	79.48	76.91
Percentage of respondents stating the number of members of the WUA staff are males	99.78	87.89	100	100
Percentage of respondent stating the number of male members	94.17	86.62	97.46	99.81
Percentage of respondent stating that women are not actively playing roles in the managerial board and membership	62.68	46.48	84.14	92.86
Percentage of respondent stating that the WUA is beneficial to the members	95.11	83.83	75.20	71.61

Based on the data of the field research, it was found that the WUA membership consisted of landowners, farm laborers and other water users (table 14). Those included in the last category were fishpond owners, sugar plantation owners, industrial owners and the like. Most respondents of the four systems said that the status of the majority of members was landowners or farm laborers. It was because of the limited area ownership that the farmers who have a status as landowners were still able to work other lands. In general, all of the members have the same rights and obligations without differentiation on their social and economic status.

The existing data also showed that the WUA membership was dominated by men. This indicated that women's involvement in farming is still low. The same phenomenon could also be seen on the respondent opinion on women's participation in the WUA activities. In general, the respondents of the four systems stated that women did not involve actively in the WUA activities. On this aspect, respondents of the Krogowanan system gave the lowest value. Of the respondents, 53.52 percent said that women in the Krogowanan system were active in the WUA activities. This means that women in the Krogowanan participated more actively in the WUA activities than those in other systems. This was made possible for them since there was an IMT in 2000, and farmer women in the Krogowanan system got established through the Woman Study Center of Diponegoro University.

In order to run the activities the WUA had staff. The majority of the respondents said that members of the WUA staff were elected through WUA discussion. On this aspect, respondents in the Krogowanan system gave the lowest values for answers. This is because the WUA was a relatively new organization and, at first, it was aimed to fulfill the project demands.

From the side of being active, the Kalibawang respondents gave the highest answers. The WUA in the Kalibawang system was run better and was more organized than those in the other three other systems. Even so, it has not been able to definitely measure how much effective the WUA staff efforts were to make progress on the WUA as a farmer institution.

So far, most of the respondents have stated that the WUA has benefited its members. Through the WUA, the water was more evenly distributed so that it could reduce the possibility of the occurrence of water conflicts. From the data above, it can be seen that the respondents in the Kalibawang system have answered with the highest value, i.e., 95.11 percent. This indicates that the WUA in the Kalibawang system had been run better than those in other systems. Some respondents have stated that the WUA neither benefited its members nor guarantee the maintenance of the waterworks.

Table 15. Respondent opinion on the WUA meeting.

Aspect	Kalibawang	Krogowanan	Glapan	Klambu Kiri
Percentage of respondents stating that the WUA meeting is held:				
- once a season	16.14	19.81	49.34	63.17
- selapan (35 days)	51.73	-	5.63	2.92
- uncertain time	26.89	68.15	20.01	22.32
- others	5.24	12.04	25.08	11.59
Percentage of respondents stating that at the WUA meetings problems that the members face are discussed				
- Water distribution	34.33	16.48	63.26	39.96
- O&M	29.71	28.94	14.40	24.77
- Others	35.96	54.58	23.33	35.27

One WUA activity is a meeting held in order to support its smoothness, but its implementation time is different for each WUA. Most of the respondents in the Kalibawang system stated that the meeting was held once every 35 days (*selapan*), in the Glapan system, that in the Klambu Kiri system it was held once for each period or season and that in the Krogowanan it was not held for a certain time. From the above results, it can be seen that in the Kalibawang system the meeting was held relatively more often than those in other systems (table 15).

Based on the results of research, water distribution, O&M, interblock relationship, sanction, profit sharing, and the like were the most often talked topic in the meeting. In the Krogowanan system, 16.48 percent respondents said that water division was the discussion topic. This is because farmers in the Krogowanan never had water distribution problems for, during the year, most farmers in the Krogowanan area always got water.

Table 16. Respondent opinion in the O&M activity.

Aspect	Kalibawang	Krogowanan	Glapan	Klambu Kiri
Percentage of respondents involved in maintenance of:				
Tertiary canal				
- Often	95.11	92.94	18.09	16.49
- Sometime	2.65	5.94	11.68	10.47
- Seldom	2.23	1.12	70.23	73.03
Secondary canal				
- Often	20.05	25.92	3.75	8.20
- Sometime	24.72	2.22	9.62	0.40
- Seldom	55.23	71.86	86.63	91.49
Primary canal				
- Often	7.46	10.71	3.75	4.70
- Sometime	7.32	14.28	9.62	0.30
- Seldom	85.22	38.10	89.63	95.00
Percentage of respondent stating that members of the WUA contributed to social work in				
- Money	78.72	39.69	51.00	44.19
- Material	11.24	61.66	14.09	7.41
- Labor	99.42	90.62	27.05	27.86
- Others	0.50	-	-	-
Percentage of respondents stating that the WUA got irrigation funds from the government				
- Yes	36.76	21.08	1.09	0.60
- No	41.71	40.81	72.09	73.75
- Don't know	21.53	38.11	26.81	25.64

Table 16 shows respondent opinion in the O&M activity. In general, O&M activities done by the WUA were minor works, which aimed to smooth the waterworks. Based on the field-research findings, it was seen that respondents in the Kalibawang and Krogowanan systems answered with the highest value in waterworks maintenance, especially in the tertiary and secondary waterworks. This means that the farmers from these two systems had a higher involvement than those in the other two systems. It was the same where contribution for the mutual cooperativeness (*gotong royong*) was concerned; the respondents of both systems contributed much more, such as in money, goods, and even power or energy. However, close attention should be paid to the data since there was a striking difference between the systems, where the Kalibawang and Krogowanan systems had an IMT program while the Glapan and Klambu Kiri systems had no such program.

The member contribution was one of the sources for irrigation funding. Most of the WUAs were not able yet to meet all the irrigation funding that had become their authority. Therefore, WUAs could propose financial assistance from the government. So far, the local government of Kulon Progo and Magelang regency had provided funds to the WUAs for such a necessity. However, based on the research finding, it was found that not all the farmers had known about the government financial assistance to the WUAs. In the Glapan and Klambu Kiri systems, the government had not provided such a fund so that all respondents stated that they did not receive government assistance.

Appendix 6

Qualitative Analysis: Agricultural Poverty

Poverty is a crucial social problem that requires serious attention. Although many factions have already performed efforts to solve the poverty problem, it seems to be a very general problem. Therefore, in most cases, the efforts made for poverty alleviation do not touch its target. However, the poverty suffered by farmers is different from that suffered by industrial laborers.

Farmers in Java, especially in irrigated areas of the Klambu Kiri, Glapan, Krogowanan and Kalibawang systems in Demak, Grobogan, Magelang and Kulonprogo Regencies, also suffered from poverty. Programs conducted to alleviate poverty have, so far, not succeeded.

A survey of 900-farmer household found that 39.14 percent of the farmers are categorized as poor based on criteria of the National Statistical Bureau. Poverty measurement used is total farmer income, from both farm and off-farm income. The average income per capita of farmers in the selected area is shown in table 17.

Table 17. Average income per capita in the selected area.

No.	System	Income (Rp/capita/year)
1.	Klambu Kiri	2,317,666
2.	Glapan	2,201,333
3.	Krogowanan	1,757,333
4.	Kalibawang	1,855,333

Source: Primary Data 2002.

Farmers in the Klambu Kiri system have the highest income per capita compared to those in other systems. It is then followed by farmers of the Glapan, Kalibawang and Krogowanan systems. Meanwhile, the role of the agriculture sector to the family income varied from 50 percent to 62.5 percent. Contribution of the agriculture sector to the family income is highest in the Klambu Kiri system.

The perception of people on poverty is generally homogeneous. Poverty is related to landownership and cattle, especially cattle used for land preparation; then it is related to the ability to send children to school. When a farmer owns no piece of land or a very small piece of land, he is considered poor.

Farmers are getting poorer because they suffer from government policy on product price. This is called structural poverty because if farmers could determine their product price they would have more power and would not be poor. As a producer, farmers have never received a proper exchange value for their products. Farmers always receive a lower price than the ceiling price determined by the government. On the other hand, yearly farmer consumption is usually higher than their income. As a result, the deficiency should be bought from the free market by using a price that is higher than their selling capability. Farmer losses are getting bigger because the availability of seed, fertilizer and pesticide is limited and their price is high.

Crop failure due to pests and diseases worsens the farmer condition. Some farmers blame the geographic location of their rice fields as having infertile soil, limited irrigation and limited access to the market because it is located far from road access. They will all affect the nominal production value accepted by farmers.

Farmers, who have very small pieces of land or no land at all, generally work as farm laborers or sharecroppers. Farm labor works seasonally at the beginning of the planting season and at the harvesting period. Types of work at the beginning of the planting season are land preparation, transplanting and maintenance. Wages for farm labor varies from place to place. In the Kalibawang system it ranges from Rp 7,500 to Rp 10,000 per day while in the Krogowanan system it ranges from Rp 10,000 to Rp 15,000 per day. Labor wages in the Glapan and Klambu Kiri systems vary from Rp 9,000 to Rp 15,000 per day. The wage difference between male and female labor is more or less 20 percent. In the Klambu Kiri system, the alternative job available is labor in the cigarette industry, which provides higher wages, that is Rp 20,000 per day. Because wages of off-farm jobs are higher, many farmers are more interested in working in off-farm jobs so that the agriculture sector found difficulty in getting labor.

The relationship between landowner and laborer is a traditional relation without any commitment. Farm laborers have no guarantee that the landowner will employ them in the future. It means that the landowner can employ farm laborers as they wish without any commitment. As a consequence, a farm laborer has a weak bargaining position and cannot request anything except accepting employment from the landowner. It is also possible for a landowner to employ laborers from outside the area if there is no agreement between the landowner and laborer.

For sharecropping activities, the share between the landowner and sharecropper differs from one crop to another and from one place to another. For rice in all selected areas, the share is 1: 1 or 1: 2. It means that from the total production one part belongs to the landowner and 2 parts to the sharecropper. All costs of production become the responsibility of the sharecropper. The variation of share for other crops is shown in table 18.

Table 18. Sharecropping.

No.	Crop	Share
1.	Mungbean	1: 2
2.	Chili	1: 3 or 1: 2
3.	Cucumber, caisin, cabbage	1: 2
4.	Melon, watermelon	1: 2
5.	Onion, leek	1: 9
6.	Vegetables	1: 2

Source: Primary Data 2002.

Besides becoming sharecroppers, some of them also practice *bawon*, which is applied in harvesting. In the bawon system, wages are taken as a share of yield they can collect. As in sharecropping, the share depends on crops and location.

The relationship between the landowner and sharecropper is imbalanced. The sharecropper gives more efforts and is responsible for the uncertainty due to crop failure. All labor use and production costs paid by sharecropper become a risk in case of crop failure. On the other hand, in the case of successful harvesting, the landowner receives the same benefit or even more.

Based on a framework that poverty of farmers is different from other type of poverty, it is clear that poor farmers consist of small farmers (sharecroppers and laborers). To date, the farmer poverty remains unsolved. Farmers still face such problems as insufficient water, land conversion, transfer of landownership, improper credit procedure, limited access to information and an imbalance in economic relationship.

Efforts made for poverty alleviation of the farmer have a strong relationship with the success of rural development. Therefore, of late the government seems to be making an effort to solve the poverty problem. Some of the indications are choice of poverty alleviation as an official program of a five-year development plan, establishment of the position of an assistant to the National Planning Agency division of poverty alleviation, as well as the launching of some poverty alleviation programs.

However, the problem of poverty is not that simple. It is related to the determination of the poverty line. Although the government stated that the number of poor people had reduced from 60 percent in 1970 to 15 percent in 1990, this only shows the number of population that consumed less than 260 kg of rice per year. The number of people below the minimum calorie consumption line cannot reflect the measure of the poverty problem.

Efforts made for poverty alleviation are giving charity; they are partial in nature and are dependent on budget availability. Therefore, it seems difficult to effectively solve the poverty problem. Farmers of other poor groups in rural areas cannot be empowered by charity programs or operational techniques alone. This is because their poverty is structural poverty caused by human factors, such as unequal distribution of productive assets, discriminative economic policy, corruption, collusion and economic arrangement that benefit certain groups only

Appendix 7

Qualitative Analysis: Irrigation Performance and Implication for the Poor

The followings are system descriptions and performances based on the qualitative analysis.

Kalibawang System (6,454 ha)

General Description

The Kalibawang system diverts water from the Progo river and it consists of six interconnected schemes namely Kalibawang (1,525 ha), Donomulyo (480 ha), Penjalin (652 ha), Papah (983 ha), Pengasih (2,075 ha) and Pekik Jamal (739 ha). The Sermo reservoir provides additional water supply to the system through the Serang river. Administratively, the Kalibawang system serves the command area in the Kulonprogo Regency of Yogyakarta Special Province. Among those schemes, Kalibawang, Pengasih and Pekik Jamal are selected as samples.

Kalibawang Scheme (1,525 ha)

Water resource. The Kalibawang scheme diverts water directly from the Progo river.

Management. Its management has already been transferred to WUAF Kalibawang I and Kalibawang II. Water distribution is conducted by a water master, who is a government official, and an engineering staff (*ulu-ulu*) of each WUAF, based on the water requirement in the tertiary unit. They are also responsible for conducting regular maintenance activities. Rehabilitation of the Kalibawang Primary Canal is supported by WUAF of other schemes in the Kalibawang system besides by the WUAF Kalibawang I and Kalibawang II because it supplies water to other schemes.

Infrastructural condition. The infrastructural condition is generally good to very good. It is maintained well because it affects other schemes in the system.

Environment. The scheme is located in a favorable place for agriculture. Water is available and soil is composed of old volcanic material. Water quality is good without any pollution. Drainage is generally good so that waterlogging does not exist. The scheme has never experienced extreme floods or droughts.

Irrigation performance. The scheme is located in the head of the Kalibawang system, so the water availability is adequate. Groundwater abstraction for agriculture does not exist. Due to the good infrastructural condition, water losses along the main system are very small. Water supply equity between head and tail parts is generally good.

Agriculture. Planting pattern applied in the scheme is generally rice-rice-rice and rice-rice-upland crop. Because water is available even in the rainy season, some farmers keep growing rice throughout the year. Upland crops grown in the dry season are generally soybean and maize.

Pengasih Scheme (2,075 ha)

Water resource. The Pengasih schemes diverts water from the Serang river, which is supplied by the Kalibawang system and the Sermo reservoir.

Management. The Pengasih irrigation management has already been transferred to WUAF Pengasih Barat and Pengasih Timur. Water is distributed by a water master (government official) from the dam, primary canal to the main diversion structure. From the diversion structure it is divided into two secondary canals. In each secondary canal, ulu-ulu of WUAF distributes water to each tertiary block. Regular maintenance activities become the responsibility of WUAF. So far, maintenance has been inadequate; consequently, weed and sediment disturb the water conveyance in some part of the network.

Infrastructural condition. The infrastructural condition is generally good. Some canal sections suffer from leakage, weed or sediment.

Environment. The upper part of the scheme is located in a relatively hilly area and the slope is decreasing towards the tail end. Drainage is generally good, except for some parts in the tail area. To overcome waterlogging in the ill-drained area, farmers use the system. Water quality is good without any pollution. The scheme experiences annual floods in the peak of the rainy season from December to January.

Irrigation performance. Water availability in the scheme is adequate. Groundwater abstraction for agriculture exists in the tail part of the system, especially in the dry season. Generally, water losses along the main system are very small except for canal sections with leakage. Water supply equity between head and tail parts is generally good.

Agriculture. The planting pattern applied in the scheme is generally rice-rice-upland crops. Upland crops grown in the dry season are generally soybean and maize. In the lower part of the surjan, the planting pattern applied is rice-rice-upland crop while in the upper part, vegetables and upland crops are planted in strip cropping. Production rate of rice in the scheme ranges between 4 and 6 tons/ha in the rainy season and lower in the dry season.

Pekik Jamal Scheme (739 ha)

Water resource. The Pekik Jamal scheme diverts water from the Papah river, which is supplied from the Kalibawang scheme. Besides the Pekik Jamal scheme, the Papah scheme also diverts water from the upper part of the Papah river. In some part of the command area, especially the tail end, farmers draw groundwater to irrigate their rice fields in the dry season.

Management. IMT has been implemented in the scheme. WUAF Pekik Jamal Timur and Pekik Jamal Barat manage the scheme from the dam down to the secondary canals. Water is distributed by ulu-ulu of WUAF to the secondary canal and each tertiary block. Regular maintenance activities become the responsibility of WUAF. So far maintenance is inadequate; consequently, sediments disturb water conveyance in most of the network.

Infrastructural condition. The infrastructural condition is generally good. Some canal sections in Pekik Jamal Timur suffer from leakage.

Environment. The scheme is located in the downstream part of the Kalibawang system. Its topography is flat and its elevation is low. Waterlogging occurs in some areas. To overcome waterlogging farmers use the surjan system where a part of the field is higher than the other fields. In the lower part, rice is grown with a ponding system while in upper part farmers grow vegetable and upland crops. Flood occurs annually from December to January. Drought occurs in the dry season although it never destroys all crops.

Irrigation performance. Water availability in the scheme is generally adequate with seasonal fluctuation. Two tertiary blocks suffer from water inadequacy almost every time. Groundwater abstraction for agriculture exists almost in the whole of the scheme, especially in dry season. Generally water losses along the main system are very small except for canal sections with leakage. Water supply equity between head and tail parts is generally good.

Agriculture. Due to its environment that is mostly ill-drained, most farmers applied the surjan system. In the lower part of the surjan, the planting pattern applied is rice-rice- upland crops while in upper part vegetables and upland crops are planted in strip cropping.

Krogowanan System (813 ha)

Water resource. The Krogowanan system diverts water from the Pabelan river. Kunjang and Klesem rivers; some natural springs supply some parts of the system.

Management. The Krogowanan irrigation management has already been transferred to WUAF. The Krogowanan dam is operated by a water master (government official) while the WUAF distributes water from the primary canal to tertiary blocks. Regular maintenance activities become the responsibility of WUAF. Due to abundant water availability, water allocation and distribution as well as regular maintenance become a low priority in the WUA activities. However, if a rehabilitation of a structure or canal is required, farmers are willing to contribute to that activity.

Infrastructural condition. The infrastructural condition is generally good.

Environment The system is located in a relatively hilly area with a relatively high elevation. Drainage is generally good due to its sandy soil texture. Mountain spring water gives the system a very good quality of irrigation water without sediment. Only a few parts in the tail end suffer from pollution from a paper factory.

Irrigation performance. The Krogowanan system has abundant water availability. Outflow from the system is utilized by other systems downstream. No groundwater abstraction for agriculture exists in the system. Generally, water losses along the main system are very small and water supply equity between head and tail parts is generally good.

Agriculture. The planting pattern applied in the scheme is generally rice-rice-upland crops, rice-vegetables, and rice-upland crops. Upland crops and vegetables grown in the Krogowanan system are mostly high-value crops, which are in demand from the surrounding market.

Klambu Kiri System (21,475 ha)

Water resource. The Klambu Kiri system diverts water from the Serang river, which is supplied by the Kedung Ombo reservoir. The Klambu dam has a command area of 48,715 hectares divided into two irrigation systems namely Klambu Kiri or Left Klambu (21,475 ha) and Klambu Kanan or Right Klambu (27,258 ha).

Management. The Klambu Kiri system has not been transferred yet so that the government official i.e., Office of Ministry of Settlement and Infrastructure Development allocates and distributes water from the dam down to the tertiary offtake. Farmers distribute their allocated water among themselves in the tertiary block. The same office also conducts maintenance activities.

Infrastructural condition. The infrastructural condition is generally good, except for high sedimentation along the system. Wulan 1 and Wulan 2 secondary canals are not well designed so that the slope is elevating towards downstream.

Environment. The system is located in a relatively flat area. The upper part of its river basin is highly eroded so that water contains sediment, which is deposited along the irrigation system network. Soil condition in its irrigated area is mostly clayey and, therefore, its drainage is poor.

Irrigation performance. Water availability in the scheme is inadequate and timelines is low due to sedimentation along its canal network, which reduces canal capacity. Water losses happen because of leakage along secondary canals and pumping from canals to rice fields out of the Klambu Kiri command area. Groundwater abstraction for agriculture does not exist. Water supply equity between head and tail parts is generally poor.

Agriculture. The planting pattern generally applied in the scheme is rice-rice-upland crops and rice-upland crops. A few parts of the head grows rice throughout the year. Upland crops grown in the dry season are generally mungbean. The time difference between the head and tail to start the rainy season planting (first planting season) is 3 months. This shows the poor timeliness and poor equity between head and tail.

Glapan System (18,284 ha)

Water resource. The Glapan system diverts water from the Tuntang river, which originates from the Rawa Pening lake. The command area of the Glapan system is divided into Glapan Timur or East Glapan (8,671 ha) and Glapan Barat or West Glapan (10,113 ha).

Management. The Glapan system has not been transferred yet so that the government official, i.e., the Office of Ministry of Settlement and Infrastructure Development manages the system. The provincial-level office allocates and distributes water from dam to secondary canals while regency level office allocates and distributes water from the secondary canal to tertiary offtakes. The same office also conducts maintenance activities. Farmers distribute their allocated water among themselves in the tertiary block. In the Glapan system there are three levels of management, i.e., the provincial government manages the head works and the primary canal; two regencies (Grobogan and Demak) manage the secondary canal, and the WUA manages the tertiary blocks.

Infrastructure condition. Glapan infrastructure is generally old. Although some rehabilitation has already taken place, this insufficiently helps improve infrastructural conditions. Some canal sections suffer from leakage and sediment.

Environment. The system is located in a relatively flat area. The upper part of its river basin is highly eroded so that water contains sediments, deposited along the irrigation system network. Soil condition in its irrigated area is mostly clayey and, therefore, its drainage is poor. A canal section that passes the Demak City suffers from domestic trash.

Irrigation performance. Water availability in the scheme is inadequate and timeliness is low due to sedimentation along its canal network, which reduces canal capacity. Water losses occur because of leakage along secondary canals. Groundwater abstraction for agriculture does not exist. Water supply equity between head and tail parts is generally poor.

Agriculture. The planting pattern generally applied in the scheme is generally rice-rice-upland crop, rice-vegetables and rice-upland crops. A few parts of the head grows rice throughout the year. The upland crops grown in the dry season are generally mungbean. The time difference between the head and tail to start the rainy season (first planting season) is 3 months. This shows the poor timeliness and poor equity between head and tail.

Appendix 8

Qualitative Analysis: Irrigation Management Institutions, Implication for the Poor

Glapan System

Usually, the economically established farmers have a powerful access in the decision making of their village. For example, they can take a structural role easily in the WUA meeting and in the final decision making. They even take benefit from the programs of irrigation development. Meanwhile, the poor farmers, most of them the WUA members, have to confine themselves to the minor part of the programs. Many of the WUA members of the head, middle and tail have to confine themselves only to the small portion of the irrigation development. Often, the farmers who are the WUA members are still poor, for they cannot improve their wealth and thus have to migrate to urban areas in order to survive.

The polarized social structure of the rural community influences the WUA organizational structure, by which the program of irrigation development is enjoyed only by the WUA board and the village apparatus. They are the real owners of the lands cultivated by the poor farmers in their villages. Furthermore, there is a tendency for the authority of the WUA institutional structure to be centralized at the hands of the upper landowners, so that their relationship with the poor farmers is bad. On the other hand, the WUA functions of the village head, who was formerly the main decision maker, might be taken over by the farmers who have large lands in their villages.

The tail-part farmers have less confidence in the WUA organization, for they perceive that the organization is centrally formed and is nondemocratic in its election. The poor farmers feel that there is no hope for them to rely on the WUA for their prosperity. They rely on water supply. In short, they think it is useless for them to be the WUA member when the water supply is insufficient. The very less contribution of the middle and tail area farmers indicates this fact. Moreover, the farmers' burden grows heavier, when at the same time they have to pay some contribution to the village institution in the harvesting period. It is understandable that the allocated fund for the irrigation sector is only 30 percent. The ISF has been at a bottleneck for a long time, so that the contribution is limited only to its group (the contribution is Rp 15,000/ha/year). In addition, the tail farmers have less confidence in the administrators of the contribution, for water is served as a commercial commodity by the water master. There is a practice in the head area in which the farmers pay some money as a compensation for some irrigation water they get. The performance of the WUA is stagnant along with the interfered water which runs into the lower areas. The main cause is the lack of guidance from the Irrigation Service to the WUA and the lack of coordination among them. This results in the harvest failure where the family of the poor farmers is getting poorer. As it is known, the WUA's farmers are mostly the farm laborer who own only less than one hectare of cultivated land.

The major mutation in the local government institution results in the stock of the irrigation performance. The efforts to socialize the PP 77/2001 have come only to the level of the irrigation officials, not yet to the farmer level. Even the irrigation commission as the substitute of the irrigation committee has not been formed yet. Finally, the working program of irrigation management in those areas cannot establish its main priority.

Klambu Kiri System

The pressure upon the poor farmers is getting harder because the government policy on the irrigation program is only based on the target of WUA formation and ISF collection without any follow-up of the farmer prosperity. The case of the ISF has stopped as a result of the inequality in the water distribution to the rice field due to inappropriate irrigation network. Water contribution can be collected only after the second planting period, and the collected water contribution is less than 40 percent. In order to eliminate the pressure faced by the farmers, one of the ways taken by the rural community is going out from their villages and working as factory workers.

On the other hand, there is a symbolic revolt from the middle area farmers, which is aimed to change or to break the domination system of the WUA administrators. The authoritarian style implemented by the WUA head cannot be welcomed by the members, most of whom are the poor farmers. The poor farmers of the tail area, who are not the WUA members, also take a revolt, either passive or explosive, in order to demand equality from the Irrigation Service as the government institution. There is an effort facilitated by the subdistrict head to reconcile the farmers, the village apparatus and the irrigation officials, but the final agreement has not been achieved yet. The farmers' everyday revolts tend to avoid any direct physical contact with the irrigation officials; rather these revolts are passive in nature, such as water robbing by water pumps, e.g., the case of the Klambu Kiri Primary Canal, in which the head farmers organize a water pump community. Adversely, the tail farmers' sceptical attitude is shown by diverting water from drainage with their own resources. Although there is no WUA in their village, an informal institution organized by themselves had already existed, which has been very solid.

The WUA's organizational sanction in the head, middle and tail areas almost does not work, for the relationship between the WUA administrators and its members is not patron-client in pattern. It means that the statutes/regulations as the rule of law of the WUA do not strengthen the solidarity between the poor and rich farmers. Rather, the power is concentrated at the administrators and the village apparatus, which is accompanied by the fragmentation process among the undercurrent working farmers. The increasing number of the WUA members, which is not followed by the strong empowerment of the members, traps the farmers below the poverty line. The WUA members are relatively isolated from the WUA's working program or have no sufficient access to the latest information they need on the irrigation policy of the irrigation service. The village's elite party, including those who are at the WUA management, maintains the top-down pattern. There is even is an intervention from the village head in the policies of the WUA's institutional reorganization and an honorarium for the administrators. There is no doubt that the poor farmers among the WUA members will get poorer since they cannot keep in touch with the development progress, market information and the rural technology program.

Ideally, the statutes/regulations refer to local ordinance, since it is the duty of the irrigation commission, the field coordinator and the WUA. As the irrigation commission has not been organized, the statutes/regulations have not been able to adjust to the local condition. Since the local ordinance describing PP 77/2001 is still in design it is natural that the field officials face a dilemma. Actually, the statutes/regulations have already provided the sanction, honorarium and organizational rule of law but some administrators and members agree less with them. For example; the administrators' honoraria are insufficient. There is an argument that the budget is taken from the permanent budget of the local government and the village budget at the Regent's instructions.

The inferiority of the farmers at the head end in accessing the market information is a result of the middle trader dominance of the market distribution line. The middle traders have dominated the traditional market by absorbing the current of modern communication technology. Against this situation, the WUA and the rural cooperation act only passively. The poor farmers' inferiority becomes intense, especially in their bargaining position. Ultimately, their trading monopoly is held only by some people who have access to the information. The local government has not been capable of following up on this matter seriously, for it is still occupied with the local autonomy question.

Very few of the rural young generation participate in the WUA. They pay more interest in joining the labor union or working in the industrial sector so that their villages are left far behind the growing progress of the urban areas. Through the WUA empowerment it is hoped that the development in rural areas, especially those which are isolated, can constrict the poverty line. However, the irrigation and agricultural services realize that after the local autonomy, the impact of the rural technology program by the training transformation for skill improvement is very low. It is rare to see the field officials at the rice fields for, after the local autonomy, they receive no honoraria. The latest breakthrough is organizing a routine meeting with the WUA, the field guiding group and the farmer group every month.

Kalibawang System

Pekik Jamal Scheme

The ration of the poor farmers in this area is 45 percent, the majority of whom are WUA members. Although field officials of the agricultural and irrigation services have empowered the farmers in order to improve their prosperity, still there is no significant improvement. About 80 percent of the farmers in this area are WUA members, most of whom are farm laborers. With less than 400 m^2 of cultivated land, it is ordinary that only 10 percent the farmers do not belong to the WUA. The WUA has not played the role as the farmers' supporter in the determination of crop prices, indicating the weakness of the institution before the usurers. The farmers' bargaining position is as weak as the WUA's support. Possibly, it has resulted from the WUA's lack of its own cooperation that accommodates the farmers' crops. Establishing cooperation is not easy because it requires a corporate body.

From the 80 percent members, the collected ISF is only 30 percent. The main problem is the ISF collectors' lack of effectiveness in performing their duties, though they received 20 percent of the collected fund. Thus, it is understandable that there is no increase in the levy. Actually, there is already a plan for revitalizing the ISF levy in order to revive its controlling mechanism function. As a solution, the administrators and members agree with the ISF collected since the first planting period. For example, they agree with the direct collection of the ISF from the farmers after two rice harvests.

Although the implementation of the irrigation programs financed by the stimulant fund has offered benefits to the rural community as a whole, its influence on the poor farmer level is not equal as yet. Perhaps, it is useful to introduce the IMT-like programs, as has been done by the government so far, but the benefit does not reach the projected target. Against this, the irrigation service has socialized the PP 77/2001 to the WUA level and it has responded positively.

Pengasih Scheme

The institution in the head area can be categorized as good enough, based on the WUA staff's activity and work program. The WUA staffs run their activity well although they should cover a wider area. As long as three working years, the board of manager has successfully performed six activities consisting of a) the development of the diversion structure, b) canal rehabilitation, c) tertiary canal upgrading, d) water gate rehabilitation, e) sedimentation dredging and grass cutting, and e) the group's working area mapping. The condition is similarly found in the tail, middle and head where social work has been well performed. The meeting of the tail, middle, and head cluster is usually held at 19:30. However, there is also a weakness in the manager's capability in getting the members to attend the meeting.

In the items of clause of rules of association and its platform, there is a weakness requiring attention and improvement. The platform and rules of association were originally carried out in 1990 collectively by several WUAs in the head. It is possible that at that point of time they did not anticipate there could be any clause that was not suitable for the area development. Fortunately, they make use of PP 77/ 2001 as a handout for reforming to reorganize the performance of WUA. PP 77/ 2001 is socialized by the officer of the irrigation office in each WUA. Irrigational and agricultural coordination can be categorized as good. It cannot be separated from the irrigational and agricultural officer's role in WUA guidance.

ISF is levied through farmer groups in each village. Then, it is ceded to the unit of WUAs and later to the union of WUAs. Farmer's awareness in the head to pay ISF can be categorized as very low, especially that of the poor ones. The target only reaches 30 percent. The rules say that farmers should pay Rp 15,000 per hectare per year. This is too much for the poor farmers to pay.

Kalibawang Scheme

The WUA in the head has performed democratically through a meeting and a voting system. The WUA has held many meeting although not routinely. The meetings are usually held on Sundays. Since IMT is applied, there is transparency in the annual report such as the work plan achievement and expenditure. The work plan, such as the canal rehabilitation in the early rainy season, is outstanding. Farmers have realized the significance of being a member of WUA after getting the required water. It means the members can improve their prosperity.

Although ISF has reached 98 percent, paying Rp15,000 per hectare per year is felt as a burden, especially, if it is levied after the planting season. Therefore, farmers in the middle and head propose to the WUAF that ISF should be paid at harvest time. For the farmers in the tail feel that their need of water is sufficiently satisfied. The Rp 20,000 per hectare per year levied and the 15 kilogram of rice per hectare/year collected have reached 95 percent of the total targeted. The WUA in the tail can be categorized as better as the landownership is, in average, around 3,000 m^2. The direct impact of the WUA begins to be felt by the farmer after being able to have two harvests in a year.

The price of dried rice at harvest time highly decreases to Rp 1,300 per kilogram, which is such a bad impact on the farmers. The price is set as the absolute price obligatorily accepted by farmers. The unwillingness of the traders and the cooperation to accept the farmers' rice is the cause of the price decrease. The market information accepted by the farmers is in one direction, meaning that the government policy concerning the rice price is known only by the traders. A few people run rice domination. It is normal if the farmers change their jobs to creators of handicraft.

Krogowanan Scheme

After IMT, the spirit of traditional meeting has been transformed into the WUA context to eliminate the domination of the irrigation officer and the rural apparatus. The effort to revitalize the performance of WUA is only to positively prompt the agricultural production and to pursue economic growth of the members, for example, scheduling the meeting of irrigational block manager. Since IMT is established, WUA has been playing a significant role in a cognitive and normative system. In fact, before the IMT is established, sometimes there is managerial vacancy. It is different from the tail WUA where the managerial position has never been vacant. The change is due to the retirement of the manager. This complicated problem emerges as a consequence of the slow succession and regeneration so that disharmony generates among the managers. Unfortunately, meetings held every Tuesday do not result in any solution.

Although the WUAs in the tail can be categorized as good, the poor farmer constitutes 40 to 50 percent of the total rural people. This does not include the 20 percent of the outside laborers of the agriculture sector for the youth prefer to work in urban areas. The trend is worsened by the action of not giving ISF levied to the WUA. ISF is levied based on the area of the terrain viz. Rp 2,000 /1,000 per m^2. Rp 1,000 is given to WUAF and the rest is managed by the WUA. On average, the ISF levied is as much as Rp 1,000. ISF is meant to reduce the gap and eradicates poverty but it still exists and tends to polarize in certain area than in others.

Formerly, the amount of collected ISF reached 100 percent but now it decreases up to 80 percent. Before IMT was established the ISF was collected at the same time as the traditional ceremony "*Perty Deso,*" similar to the social work held annually to rehabilitate the canal. Farmers propose that the collection should be done seasonally after harvest time. However, the absence of an officer to levy ISF results in poor ISF collection. So far, the head of the village occupies the post of collecting ISF. To strengthen the aspect of the socioeconomy, some decisions are made at the intern meeting. Details are as follow: 50 percent of ISF is used for maintenance, 20 percent for operation, 20 percent for collecting expenses, and 10 percent is ceded to the WUAF.

The ISF in the tail area is stagnant for the person in charge does not do the job. The Rural government plans to go down to handle the problem and assign a person to collect both the ISF and the data on the area width of the farmer's terrain. However, this plan is not easy to perform as farmer's income is still below Rp 250,000 per month. Moreover, the problem of the tail farmer gets complicated as the ISF is a burden to the cultivating farmer and fishpond owner. This burden has no influence on the rural people's prosperity as they earn an income not only from the agriculture sector but also from off-farm jobs.

Irrigated Agriculture and the Rural Poor

By

Effendi Pasandaran

Introduction

This paper attempts to highlight the key developments that have taken place in irrigated agriculture and irrigation system management in Indonesia.

The focus of the attention is on the development trend that occurred during the last three decades, the characteristics of the policy decision in each of period, and how the policy decision on the period influences the policy decisions on the subsequent period.

Finally, this paper discusses the links between irrigated agriculture and the rural poor and suggests the possible ways to strengthen the capacity of the rural poor in irrigation system management.

Development Trend

In response to government decentralization policy, for some years, there has been a growing concern on the need for policy reform on important natural resources, such as land and water and bio-diversity,

Since the early 1970s, with the initial phase of intensive development program, various policies, specifically at the macro and agriculture sector, have been implemented to foster agricultural growth. There are several milestones that have to be considered in assessing the impacts of these policies on irrigated agriculture and the rural poor.

First, the period from 1970 to 1984 was characterized by heavy government support to the agricultural development in general and irrigated food crops in particular. By the 1980s irrigation investment accounted for more than a half of the public expenditures on agriculture and irrigation with public-funded irrigation accounting for more than 85 percent of the irrigated area and 75 percent of the country's production (Pasandaran and Rosegrant 1995). Large amounts of resources were put in place to ensure that production inputs were accessible and affordable by farmers in all parts of the country. Among other inputs are price subsidy and a national delivery scheme for fertilizer throughout the country. Similarly, specifically for rice, the farmer's income was ensured by the guaranteed price scheme.

Second, the period from 1985 to 1997 was characterized by declining government support to agriculture in terms of investment on infrastructure and production program for agricultural commodities. The government support to agriculture can be indicated as the agriculture-orientation index (AOI), which is defined as the share of expenditure of the agriculture sector to the national development expenditure divided by the share of the agriculture sector GDP to the national GDP. As reported by Takumi Inoue (2002) the AOI declined gradually from 0.759 from 1984 to 0.387 in the year 2000. The other important policy changes during this period were the removal of the input subsidy, such as that of pesticides, the banning of imports of the broad-spectrum pesticides in 1987 and the removal of the fertilizer subsidy in 1997.

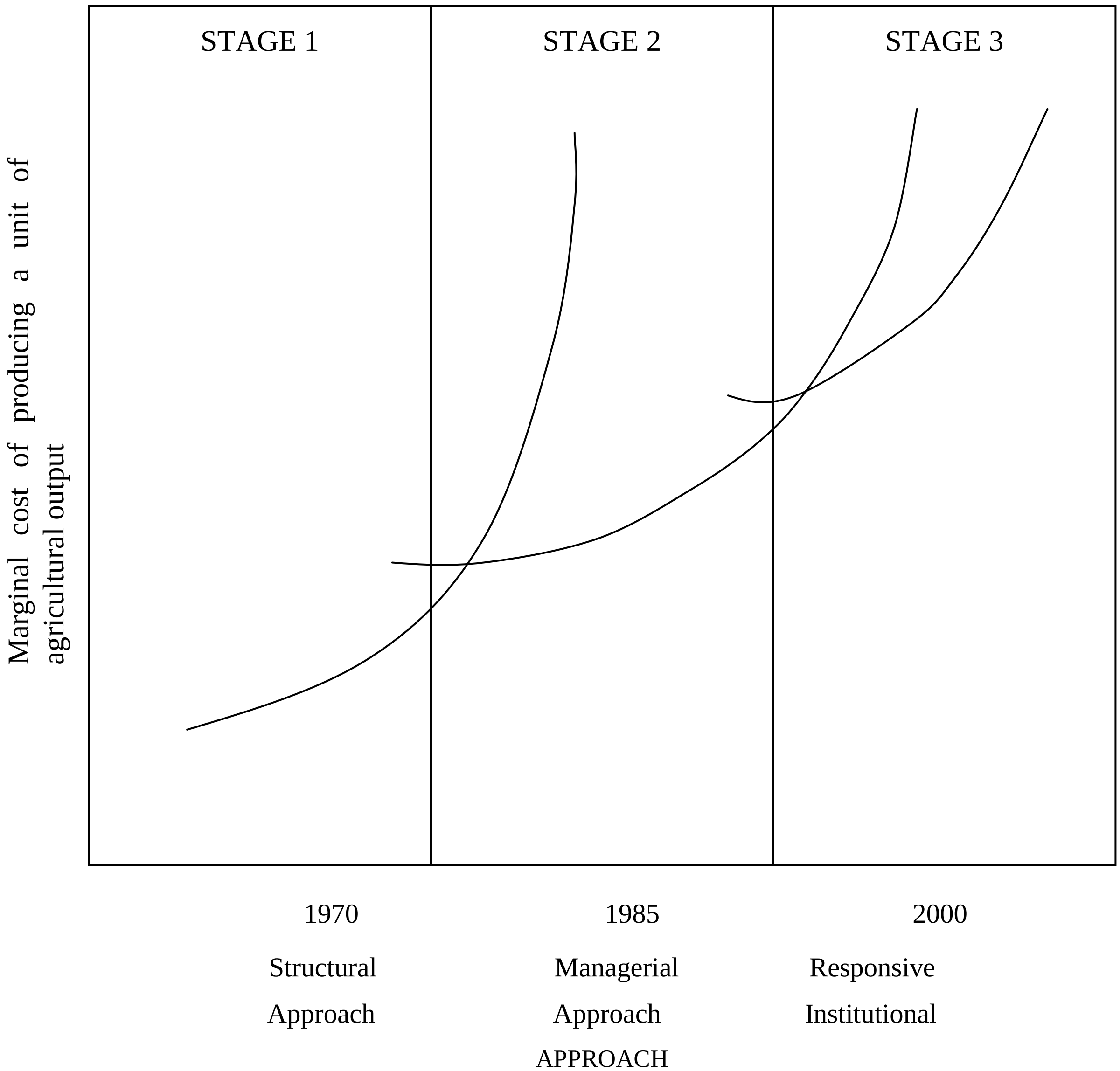
Third, the period from 1997 to date was characterized by a) an economic crisis, and b) the decentralization of the government to the district level. These fundamental changes certainly have a significant influence on the local-specific policies that will likely to be put in place by the local government, which then will lead to different agricultural development paths.

The impact of the policy reforms to irrigated agriculture can be traced through the impact of the changes in the macro-economic environment to the agriculture sector as a whole including that of irrigated agriculture and the impact of the decentralization process on the management of irrigation system. The impact on both irrigated agriculture and irrigation system management has to be placed within the framework of river-basin management. For example, the impact on water allocation in an irrigation system may be determined not only by factors such as the changes in rules in water allocation as a consequence of the changes in jurisdictional boundaries and the key actors in irrigation management but also by the changes in the line uses in the upstream part of the river basin, which may consequently influence the stream flow on the irrigation system that is also influenced by the sediment load of the stream flow that, in turn, may influence the decision on water allocation.

As a further consequence of the changes in rules, and decision-making process and continually increasing pressure on resources, the conflict might occur between upstream and downstream communities competing for scarce water resources or between local communities or large-scale private companies vying for the allocation of forestland. Competition might also occur in each hierarchical level of the system. The challenge ahead is to define the acceptable management rules and allocation criteria to manage the conflicts and, at the same time, to improve performance of water allocation and efficiency of the system operation.

The management of irrigation during the first policy chronicle (1970–1984) was heavily centralized because, during this period, the government was in great pressure to pursue the target of self-sufficiency in rice production. During the second period of the policy chronicle (1985–1997), the tension for rice self-sufficiency reduced and the support on irrigation investment gradually declined. The first period can be considered as the stage of structural approach where the marginal investment continually increased. The second period can be considered as stage of management approach with a relatively low marginal investment cost (figure 1).

Figure 1. Hypothetical stages of development of irrigation system management in Indonesia.



During this period, the concept to improve O&M was introduced. It included the concept of irrigation fee for the tertiary-level irrigation management, and the tryout of the transfer of irrigation management to the water user association (WUA).

The problems associated with the second stage was essentially the consequence of the approach used in the first stage that caused high dependency of the local communities on the public investment, which was then followed by the cooptation of the management by the government on the irrigation system initially developed by the local communities. As a further consequence, the irrigation area managed by the local communities was reduced but the area served was increased by the public agency. The adoption of the standard design and implementation procedures has weakened the internal dynamics of the WUA and, hence, it has reduced the participation in O&M of the irrigation systems that they used to manage.

The recent policy issues that have important links with irrigated agriculture are the water-sector reforms. First, as a further consequence of decentralization of the government tasks is the transfer of the management responsibility of water resources to the district level, which include the management of irrigation. The management of the small-scale irrigation has to be gradually transferred to the WUA. The second is the need to develop a concept of Integrated Water Resource Management, the policy issue launched in the second “World Water Forum” in The Hague, Netherlands, in the year 2000.

Investment Decision Links

The abovementioned policy issues have to be placed within the frame of the long-term direction of irrigation development in Indonesia. In the long term, food insecurity, malnutrition and unsustainable use of natural resource remain major problems and, therefore, the support for the further development of irrigated agriculture needs to be continued together with the development of the sectors to foster economic growth, to reduce poverty, and the water-resources management, to enable the implementation of inter-sectoral transfer of water.

In this respect there are two policy dimensions, which have to be taken into account. The first is the vertical dimension, to enhance a further stage of irrigation development. The process of decentralization can be considered as a momentum to further reform water resources management in Indonesia. The objective of the reform at the third stage of development is to strengthen the capacity of the local community to develop and manage water resources in general and irrigation in particular. As the competition for scare water increases there is a need for capacity building at the local level to accelerate the process of diversification of the irrigated rice-based farming systems.

Even though at the second stage, the management approach has been introduced and, within the process of decentralization, the legal framework has been prepared to enable the transfer of management to the WUAs these reforms are only a necessary but not a sufficient condition. Further policy reforms and investment decisions are needed to revitalize the local-level institutions and to strengthen the social capital for development of a responsive irrigation management (Pasandaran et al. 2002). At this stage of development, the local communities are responsive to translate the market signals into water management practices required to support a market-driven irrigated rice-based farming system.

Second, a horizontal dimension is related to the effort to increase production capacity through expansion of irrigated area and the increase of cropping intensity. It is very likely that the capacity for expansion is already limited. During the last five decades, irrigated rice in Indonesia only increased from 3.5 million hectares in the early 1950s to 5.0 million hectares, an increase of about 50 percent. In 1955, the total irrigated area in the world was about 80.0 million hectares while in the year 2000 it increased to 240 million hectares, an increase of about 200 percent (FAO 2000). During the same period, the population of Indonesia increased from 60 million people to about 200 million people. In other words, the speed of irrigation development in Indonesia during the last decades was far below that of the global level. Despite this development, the expansion of irrigated area or other possible alternatives, such as a tidal swamp-based and dryland area for food crop need to be undertaken because of a continuous conversion of irrigated lands in Java to other uses.

Table 1. Potential and suitability of irrigation expansion in Indonesia (ha).

	Potential for irrigation expansion	Potential land suitability	Expansion suitability
Sumatra	731	3,991	731
Java	22	240	220
Bali & NTT	59	2	0.58
Kalimantan	595	0	0
Sulawesi	137	790	137
Irja/Maluku	675	264	264
Total	2,417		1,410

Sources: Bina Program Pengairan 1991 and Hidayat et al. 1998.

Data in table 1 show the potential for irrigation expansion in major islands based on the potential of water availability and land suitability. Although there is a potential for expansion it has to be viewed from an economic feasibility perspective. It is estimated that there is a need to increase about 20–25 percent of the existing irrigated area to maintain the requirement of the food security in the year 2020.

Irrigated Agriculture: Poverty Links

The link between irrigated agriculture and rural poverty can be approached by using the framework proposed by Reardon and Vosti (1995), which is to link between rural poverty and the environment. Conceptually, there are conditioning factors affecting both the asset component of the poverty, such as natural resources, human resources, on-farm and as well as off-farm resources, and the environment components, such as soil, water and biodiversity. The conditioning factors that affect both components are household production and conversion technology, village-level asset and population pressure. The household and village behavior are measured in term of income generation, consumption, investment in asset, migration and fertility.

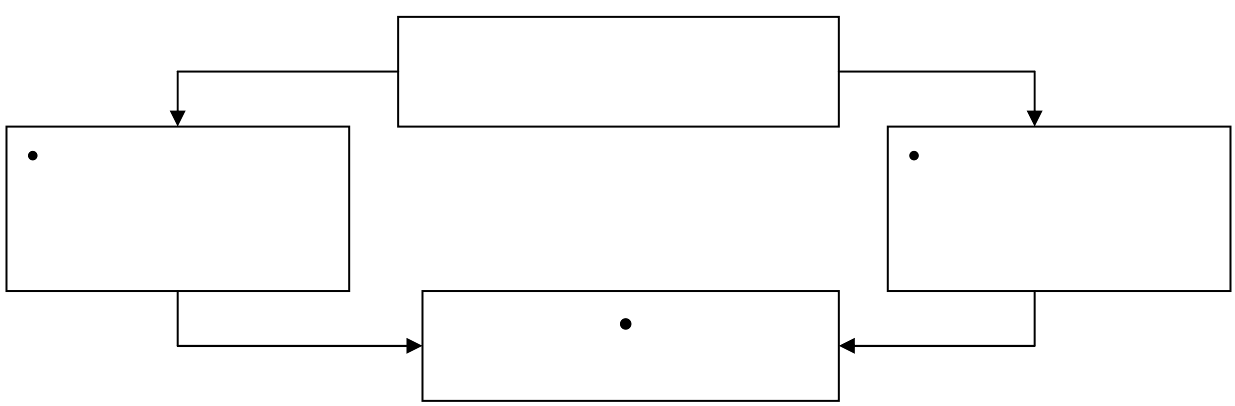
In addition to the so-called "welfare poverty," which uses criteria, such as income, consumption and nutrition they propose the concept of "investment poverty." The cutoff point is the ability to make minimum investment in source improvement to maintain or enhance the quantity and quality of the resource base that is to forestall or reverse resources degradation. The cutoff point is considered site-specific, a function of local labor and nonlabor input costs, and the type of investment that is needed for the particular environmental problems or risk faced.

With the transfer of irrigation management to the WUA the farmer in an irrigation system is responsible for manage the system; the question is weather they have the capacity both in terms of labor and income, which is above the investment poverty. The modified framework is shown in figure 2.

Figure 2. Irrigation development-poverty link.

Reardon and Vosti framework

Conditioning Factors



Conditioning factors are the macro-economic environment affecting the investment decision for public irrigation systems. The factors such as the world price of rice and oil, GDP, and the quantity of import of rice are the major determinants of irrigation investment in Indonesia (Pasandaran and Rosegrant 1995). Investment in irrigation is expected to change the distribution of irrigated lands over major islands in Indonesia.

Table 2. The changes of agricultural land in Indonesia.

	1985					
	Irrigated (1)	Percent (%)	Dryland (2)	Percent (%)	Total (3)	Ratio of (1) to (3)
Jawa	2.482.376	60	5.921.664	13	8,404,040	29.53
Sumatra	803.113	19	18.430.162	39	19,233,275	4.18
Kalimantan	144.514	3	11.324.868	24	11,469,382	1.26
Sulawesi	436.164	11	7.226.472	15	7,662,636	5.69
Bali/NTT	287.445	7	4.323.445	9	4,610,890	6.23
Indonesia	4.153.612	100	47.226.611	100	51,380,223	8.08
	2000					
Jawa	2.604.782	52	6.343.139	10	8,947,912	29.11
Sumatra	1.077.444	21	25.034.348	41	26,111,792	4.13
Kalimantan	293.898	5	16.935.272	28	17,175,170	1.40
Sulawesi	607.449	12	7.786.702	13	8,394,151	7.24
Bali/NTT	502.898	10	4.657.953	8	5,160,851	9.74
Indonesia	5.032.471	100	60.575.414	100	65,789,885	7.65

Source: CASER 2000.

Data in table 2 shows the comparison between 1985, the starting period of the second policy chronicle, and the year 2000 (the third policy chronicle) on the major land uses in agriculture, i.e., irrigated and dryland in each region. The data do not include Maluku and Papua because these two regions are dominated by dryland only. The ratio of irrigated land in Java to the total irrigation land in Indonesia declined from 60 percent in 1985 to 52 percent in 2000 but the ratio of irrigated land to the total irrigated land in Java has not changed significantly during this period. In Sumatra, both the share of irrigated land and dryland to the total increased by a 2-percentage point, which implies the importance of Sumatra as a source of land expansion, while Sulawesi had a declining role in dryland agriculture with a slightly important role for irrigated agriculture. At the aggregate level the rate of growth of dryland was larger than that of irrigated land.

At the village level, the size of the landholding is an important indicator of the asset owned by the farmer. The population growth and conversion of irrigated land are the most likely the reason for the decline of ownership of irrigated land in Java and other areas of Indonesia (table 3).

Table 3: Average land-ownership change based on land type (ha/household)

Province/Land type	Villager-dominant agroecosystem				Aggregate	
	Wetland		Dryland			
	1994	1998	1994	1998	1994	1998
Lampung						
Wetland	1.09	0.98	1.32	0,30	0,60	0.55
Dryland	0,88	0,58	1,40	1,50	1,34	1,43
Estate land	2,62	2,04	1,40	1,41	1,41	1,42
Central Java						
Wetland	0,39	0,35	0,00	0,00	0,39	0,35
Dryland	0,68	0,99	0,46	0,42	0,47	0,47
Estate land	0,28	0,26	0,09	0,08	0,21	0,22
West Nusa Tenggara (NTB)						
Wetland	0,47	0,39	0,90	0,99	0,78	0,68
Dryland	0,00	0,50	1,05	1,15	1,05	1,11
Estate land	0,33	0,28	0,98	1,13	0,93	0,93
North Sulawesi						
Wetland	0,89	0,50	0,64	0,59	0,73	0,68
Dryland	0,71	0,00	0,62	0,88	0,64	0,88
Estate land	0,94	0,35	1,91	2,09	1,82	2,08
South Sulawesi						
Wetland	0,85	0,85	0,29	0,41	0,74	0,76
Dryland	0,50	0,50	0,71	0,42	0,66	0,44
Estate land	0,74	0,65	0,73	0,87	0,73	0,83

Source: PATANAS Census 1994,1998 (In CASER 2000).

The data on the landholding structure show a declining trend in almost all the provinces observed. In Central Java, for example, the wetland ownership declined from 0.39 hectares in 1994 to 0.35 hectares in 1998. The ownership of other types of land, such as dryland farming and estate crops has generally increased. The number of landline laborers in the rural area is also on the increase; in some villages dominated by irrigated land the share of the laborers reached 50 percent of the total of household. (CASER and World Bank 2000).

In recent years, the productivity and area harvested of major food crops in both irrigated and drylands, especially in Java tended to decline. The cropping intensity of rice in both Java and other islands has also stagnated (Pasandaran 2001). In such a situation, it would be difficult to expect the reverse of the poverty rate on the development of the agriculture sector.

The database on a sample survey of the rural poor who owned only a small landholding of irrigated area (less than 0.2 hectare) is presented in table 4.

Table 4. Household income of the irrigated rice-based rural poor (Rp ' 000)

Village sample farmer	Good accessibility to road and transport	Bad accessibility to road and transport
Downstream (Indramayu) source of income		
Irrigated agriculture	Rp 337 (9.45)	157 (3.3)
Agriculture	Rp 1,707 (47.850)	1,018 (21.3)
Nonagriculture	Rp 1,860 (52.15)	3,743 (78.6)
Total	Rp 3,568 (100.0)	4,762 (100.0)
Upstream (Tasikmalaya) source of income		
Irrigated agriculture	Rp 1,976 (73.8)	2,383 (48.58)
Agriculture	Rp 2,116 (79.0)	3,993 (81.4)
Nonagriculture	Rp 560 (21.0)	912 (18.59)
Total	Rp 2,676 (100)	4,905 (100,0)

Source: Caser 2002 .

Note: Values within brackets are percentage points.

The sample village farmer survey was undertaken, based on their location in the river basin both in the downstream and upstream part of the river basin and also based on the accessibility or bad accessibility.

The data show that in the downstream villages both the one with a good accessibility and the other with a poor accessibility the share of the household income in irrigated agriculture is much lower than that of agriculture. In the downstream village and therefore in this locale-specific situation the local communities are able to operate and maintain the irrigated sector to subsidize the irrigated agriculture sector.

On the other hand, in the upstream village, the local communities have to rely on irrigated agriculture to operate and maintain the irrigation system.

Table 5. Household labor use of the irrigated rice-based rural poor (Monday/year).

Downstream	Good accessibility to road and transport	Bad accessibility to road and transport
Irrigated agriculture	106 (3.4)	395 (20.0)
Trade	1138 (39.0)	894 (47.1)
Industry	77 (2.6)	550 (29.0)
Service	99 (3.3)	0.0 (0.0)
Livestock	1496 (52.3)	60 (3.9)
Total	2916 (100)	1899 (100)
Upstream		
Irrigated agriculture	311 (38.4)	90 (52.0)
Trade	96 (38.4)	12 (6.9)
Industry	104 (12.1)	- (0.0)
Service	40 (4.6)	10 (5.7)
Livestock	292 (33.8)	61 (35.3)
Total	863 (100.0)	173 (100.0)

Source: CASER 2000.

Note: Values within brackets are percentage points.

Data in table 5 consistently indicate the labor uses by the household. The labor uses are much large in the downstream villages compared to those of the upstream villages.

Conclusion

During the last three decades the government policies were initially characterized by substantial support to the agriculture sector (1970–1984) and then followed by a period of decline after the achievement of rice self-sufficiency in 1984 since the last few years of the economic crisis have brought about fundamental changes in economic development in general and in agricultural development in particular.

During the first period, the approach used in irrigation investment was dominated by a structural approach with the tendency of increasing investment per unit area. During the second period, the management approach was introduced to ease the burden of the government on investment and on O&M of irrigation systems; this approach, however, is constrained by weakened capacity of the rural communities because of the heavily centralized approach used in the past.

A further policy reform is suggested to revitalize the social capital of the local communities so that the management of the irrigation system can be shifted to a more responsive institutional approach. In doing this, assessment has to be done particularly on the possible sources of income of the rural poor, and the ways to improve their capacity within a locale-specific context.

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